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AUTHOR Heimbürger, Anneli
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ABSTRACT

This document is a state-of-art review of CD-ROM technology, hardware, software, and applications in library and information work, e.g., as direct replacements of large reference publications and as a substitute for and complement to online databases. Based on information published in the last three years and on information gained from international conferences and exhibitions, it provides the basics of CD-ROM technology, including descriptions of disk structure, performance characteristics, logical characteristics, and standards. Both equipment and software used with the CD-ROM are discussed, and CD-ROMs are also considered from the user's point of view. Fifty-one references are listed. Appendixes provide directories of CD-ROM drives, software packages, CD-ROM products, and CD-ROM disk manufacturers and companies for data preparation, as well as lists of information sources (online databases, journals, conferences, and additional references). (EW)

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Guide to CD-ROM

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GUIDE TO CD-ROM

prepared by
Anneli Heimbürger

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PREFACE

Recent achievements in information technology have caused remarkable changes in the traditional publishing and document delivery activities. Optical disk technology is a very good example of this. It has opened up new horizons for information processing, storage and retrieval, as well as for education and training.

Optical storage technology is rapidly emerging as a noteworthy factor in recording and distribution of information. Optical disks are durable high capacity random access memories. They can be divided into three main categories: pre-recorded optical read-only disks, blank recordable WORM (Write Once Read Many times) disks and erasable disks. CD-ROM (Compact Disk Read Only Memory) belongs to the group of pre-recorded storage devices and it will be mainly used for mass distribution of permanent information.

This document comprises a state-of-the-art review of CD-ROM technology, hardware, software and applications in library and information work. It is based on the literature published during the last three years, information gained from the international conferences and exhibitions. The potentials and limitations in using CD-ROM as substitute and complement to online access to remote databases are highlighted. The guide includes appendixes providing directories of CD-ROM drives, software packages, CD-ROM products, CD-ROM disk manufacturers and companies for data preparation, as well as information sources like journals, conferences and exhibitions.

This document has been prepared by Anneli Heimbürger, Technical Research Centre of Finland Information Service, under contract with the International Federation for Information and Documentation (FID), which is an international organization founded in 1895. FID promotes the transfer and utilization of information through international cooperation in all fields, including science, technology, social sciences and humanities. In FID, there are over 70 national and international members and approximately 300 institutional and personal affiliates from about 90 countries.

At the end of March 1987 FID brought together a group of experts with a wide range of backgrounds for a two-day workshop to review the state-of-the-art in the use of optical disks for information and documentation work. This seminar FID resulted in a contract, numbered 400.404.7, with UNESCO to prepare a guide to CD-ROM as a practical source of information on CD-ROM hardware, software, services, products and related training opportunities. This guide is meant to be used by a broad spectrum of information

professionals - librarians, archivists, record managers and end-users in developed as well as in developing countries. The work has been carried out in the Information Service of Technical Research Centre of Finland (VTT) and it was sponsored by FID, UNESCO, and VTT.

Besides the sponsors and Dr. David Raitt, FID's project assessor, Ben G. Goedegebuure, FID's professional assistant and Stella Keenan, FID's secretary general, the author also wishes to express her thanks to Sauli Laitinen, Director of VTT's Information Service, and Pirkko Eskola, Head of VTT's Information Service and Research Division, their advice and comments in producing this report.

The designations employed and the presentation of the material throughout this document do not imply the expression of any opinion whatsoever on the part of Unesco.

Readers are invited to send comments, suggestions or requests for additional copies to the Division of the General Information Programme, Unesco, 7 Place de Fontenoy, 75700 Paris, France.

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1 INTRODUCTION

1.1 WHAT IS CD-ROM?

CD-ROM (Compact Disk Read Only Memory) - "the new papyrus" has been the main theme of many international conferences during the last three years. CD technology is by no means unfamiliar to those who have browsed the record shops. CD Audio disks contain sound whereas CD-ROM contains data. The technological development from audio disks to data disks is a logical and natural consequence of compact disk technology, which is based on laser beam. The silvery sheen CD-ROM disk is 120 mm in diameter and has a hole 15 mm across in the center. It is 1.2 mm thick. The information the disk carries is molded onto one surface by the laser beam and it is represented by a spiral of microscopical small valleys and planes. Because of the recording technology enormous information storage capacity is reached.

CD-ROM disk needs a special drive, called CD-ROM drive, to transform the data recorded on the disk to human readable form. The CD-ROM drive is connected to a computer, most often to a microcomputer. The laser beam, as the read head of the drive, reads the data. CD-ROM is a read only memory (ROM); the user can't store his own data or change the data on the disk. The data on disk is in digital form. It can be a collection of text, graphics and images. The advantages of CD-ROM are huge storage capacity, 270 000 pages of text (A4), durability, standardization, and it is easy to access the data. The disadvantage is the inability to update the data on disk. The hardware needed to read the disks is not really expensive (ie. there are CD-ROM drives available for under US \$ 1000). A major factor in the high cost of CD-ROMs are the publishers protecting their interests and market. Above all CD-ROM is the new data storage media for distribution and delivery of huge amounts of information. CD-ROM technology makes it possible to access different kinds of information onsite (Figure 1).

Libraries and information services

One of the most obvious uses of CD-ROM is in the direct replacement of large reference publications, such as directories, bibliographies, dictionaries, medical reference books, statistical studies, encyclopaedias, etc. All such reference publications could be made available through CD-ROM in both public and specialist libraries. BiblioFile and Grolier's Electronic Encyclopaedia are two well known CD-ROM applications. BiblioFile was the first commercially available CD-ROM application. BiblioFile provides the complete Library of Congress machine-readable record catalogue (MARC) on three disks. Grolier's Electronic Encyclopaedia holds the full text of the Academic American Encyclopaedia, 20 volume

reference work. It covers more than 30 000 articles without pictures. The list of applications goes on and on (see Appendix 3).

Professionals

Professionals in many areas would be able to use CD-ROM in the storage and retrieval of information databases. Lawyers, for example - with their enormous legal reference libraries and indexed references - are ideally suited to CD-ROM. The same applies to doctors. For example, OSH-ROM - Occupational Health and Safety contains databases from National Institute for Occupational Health and Safety and Health Information Centre of International Labour Organization. OSH-ROM is a bibliographic database with abstracts covering toxicology, epidemiology, chemistry, industrial hygiene, ergonomics and control technology.

Design and engineering

CD-ROM can store standard specifications, design and engineering procedures, mathematical data and scientific and engineering publications of all kinds. For example, an electronic car navigation system could use CD-ROM for storing digitized road maps, street names and information about hotels and service stations etc. Different kinds of technical manuals, like a manual of an airplane, is a good CD-ROM application, because CD-ROM disks are very easy to move from one place to another.

Governmental

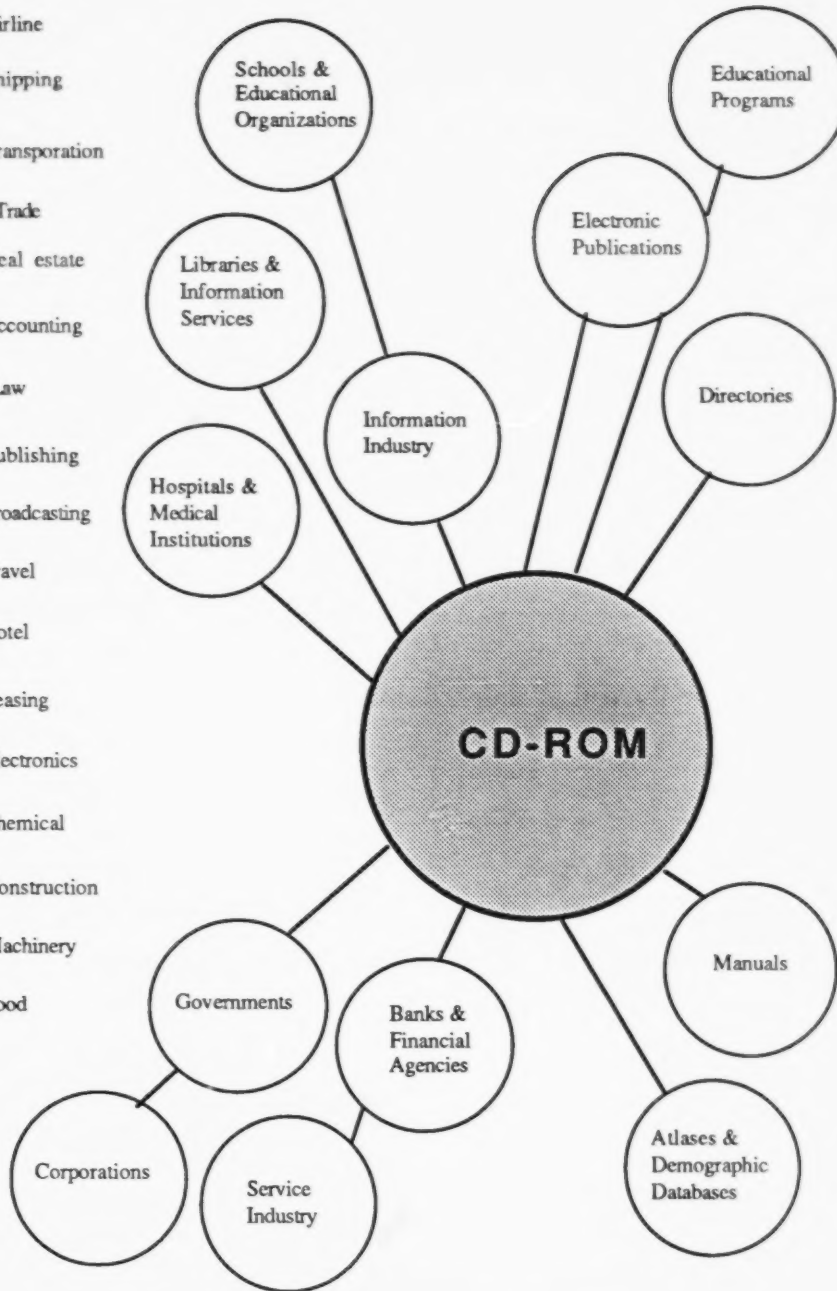
Governmental applications include, for example, publishing of social laws, juridical documents, handbooks and other reference sources. Local offices could be informed more effectively of current laws and regulations by storing them on a CD-ROM disk and sending it by post to local offices.

Commercial and financial

For example, banks can use CD-ROM in storing the signatures of their customers for fast access and verifications. Insurance companies can store procedures, standard texts and forms, actuarial data, rates etc. Travel and transport companies could distribute reference materials such as flight and rail schedules, timetables, standard reservation procedures, booking form formats etc. Computer manufacturers and software houses can distribute computer software and manuals on CD-ROM.

USERS

Airline
Shipping
Transportation
Trade
Real estate
Accounting
Law
Publishing
Broadcasting
Travel
Hotel
Leasing
Electronics
Chemical
Construction
Machinery
Food



APPLICATIONS

Training programs
Reference manuals
Customer lists
Patents
Yearbooks
Dictionaries
Encyclopedia
Telephone catalogs
Shopping information
Travel guides
Event schedules
How-to books
Guidebooks
Who's who
Part lists
Technical manuals
Annual reports
Service manuals
Operating instructions
Bibliographic databases
Full text articles

Figure 1. Examples of CD-ROM applications.

1.2 CD-ROM - AS A MEMBER OF THE FAMILY OF OPTICAL INFORMATION MEDIA

Presently, the optical information storing is a very progressive field of research. Optical information systems including hardware, software and applications have opened up new horizons for information processing, storage and retrieval. Every optical medium has its own particular features, technical properties and main application areas (Figure 2). There is an "alphabet soup" concerning different types of optical media and systems (Figure 3). The CD-ROM disk is one member of this big family of optical information media. A common feature to all of them is the writing and reading process of information made by a laser beam.

The optical disks can be divided into three groups:

1. Optical Read Only Memories (OROM) are disks on which information can be recorded once. The disks are manufactured industrially. The user cannot change the content of the disks. Videodisks and CD-ROM disks belong to this category.
2. Information on the Write Once Read Many Times (WORM) disks can stored once by the user. The information recorded cannot be updated.
3. Erasable disks which can be updated.

In addition to optical disks there are also optical cards and tapes:



Figure 2. Examples of optical media.

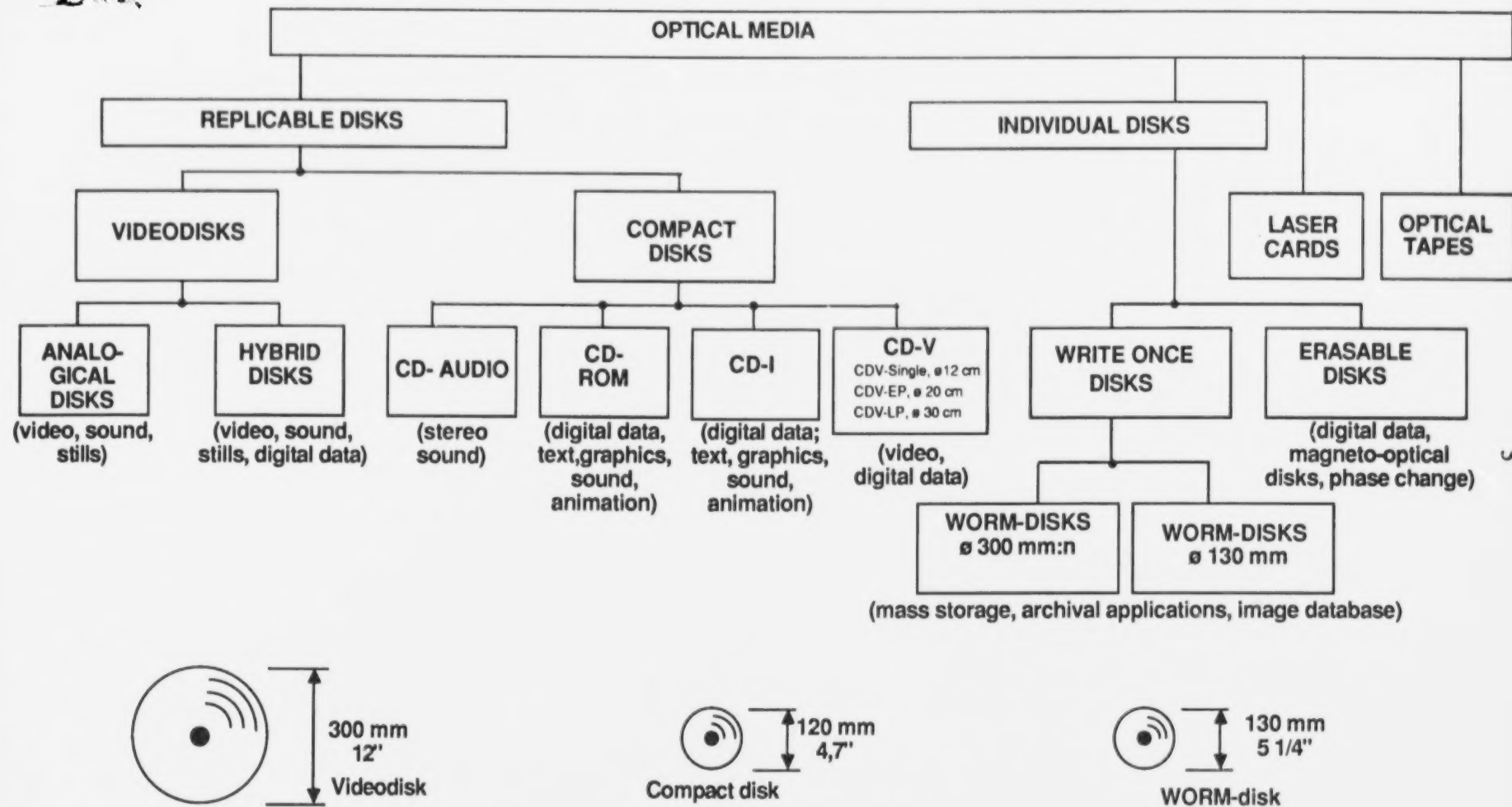


Figure 3. Optical media.

1.3 INFORMATION STORAGE CAPACITY OF CD-ROM

A laser beam is used in optical recording and reading. The laser beam draws pits on the CD-ROM disk surface. The recorded information on the disk forms a continuous band of microscopic pits. In optical reading, the read head of the CD-ROM disk drive does not touch the surface of the disk. As there is no mechanical contact between the disk and the read head there is no friction and thus no wear. Stains can easily be wiped off from the surface of the disk because it has been covered with a protective plastic layer. CD-ROM disks are direct access memories.

Besides textual information the CD-ROM disks can hold also graphics, animation, images, video, and naturally sound. The point is that a CD-ROM disk can store different kinds of information; one example is an electronic multimedia encyclopedia with text, graphics, images and sound, "talking books", and another one is a "guided tour" of an art gallery.

The storage capacity of one CD-ROM disk can be described as follows:

- 75 minutes of music,
- 275 000 pages of text (A4),
- 1 500 5.75-inch floppy disks,
- 18 000 pages of computer graphics,
- 9 000 pages of graphics and 8-bit stereo audio,
- 1 800 digitized images (200 dots per inch, 12:1 compression),
- 4 500 hours of digitized voice (16 kbs) or
- an entire text of 20 volumes encyclopedia with an index to every word, filling only 25 % of the total space on the disk.

1.4 CD-ROM - A NEW WAY TO DISTRIBUTE AND DELIVER INFORMATION

When a publisher prints for instance a book he creates an end product. The book is distributable and the information it carries is in human-readable form. Furthermore, there is only one way to read it, and it looks the same no matter how many times you do it.

When the data is put on CD-ROM, only part of the product exists. Information is indeed distributable but it is in machine-readable form. To complete the product, a delivery system, in this case a computer, CD-ROM drive, interface and necessary software, is required to translate the data into human-readable form. This delivery system is quite expensive for the user of the CD-ROM publication but on the other hand it widens the information retrieval process and

makes it more versatile. The programmability of the delivery system means that there are many ways to read a CD-ROM and both the content and the appearance of a CD-ROM publication can vary according to how it is read. This feature makes the CD-ROM publication dramatically different from all human-readable publications (Figure 4).

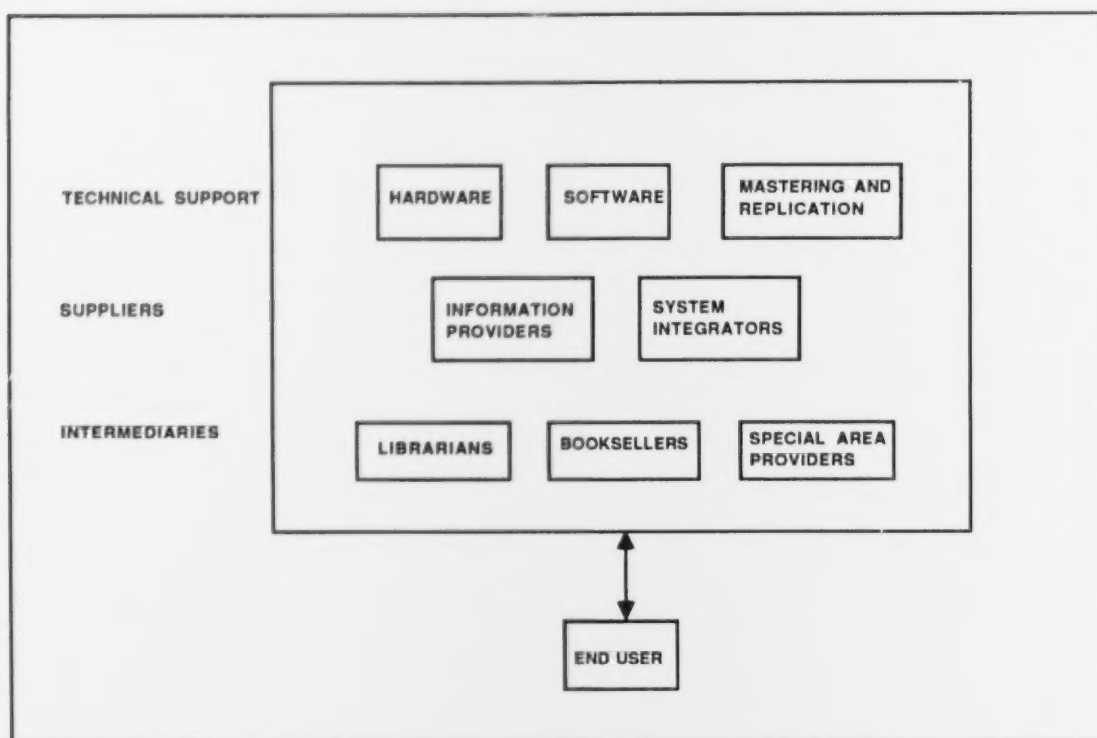


Figure 4. There are many phases in CD-ROM production and distribution chain.

There are several characteristics which make CD-ROM different from other machine readable media. These are listed in Table 1.

Table 1. CD-ROM characteristics.

STORAGE DENSITY
MEDIA STORAGE COSTS
DATA ACCESSIBILITY
DATA PERSISTENCE
MEDIA TRANSPORTABILITY
EASY TO MAIL

There are several applications in which CD-ROM competes effectively with the printed forms. Catalogs, references, business archives, medical, taxonomic and actuarial databases,

genealogies and other histories, census and cartographic data, systems documentation, process control information, instructional material etc. When CD-ROM is used as the medium, the publication is no longer the static entity that it is in printed form, rather it may be processed and delivered in any desired format.

2 BASICS OF CD-ROM TECHNOLOGY AND STANDARDS

2.1 OPTICAL INFORMATION STORAGE

Optical writing and reading is based on the laser beam. Laser (Light Amplification by Stimulated Emission of Radiation) is a light source producing a very intensive light beam containing only one wavelength. By contrast, natural light is a mixture of many different wavelengths. All optical storage devices use a laser beam which is focused to a very small spot by a special lens. The most recent drives, including videodisk players, CD players, CD-ROM drives, large and small writable optical drives, use a small gallium arsenide semiconductor laser to produce this beam. (Lambert & Ropiequet 1986; Paris 1986)

Gallium arsenide lasers produce oval beams of near-infrared light. The oval shape must be converted to a smaller circular spot about 1 μm in diameter in order to read the pits on the disk. This is not much larger than the wavelength of light in the beam, so the focusing must be done carefully. To produce the small spot, it is necessary to gather the laser beam into a sharply convergent cone of light.

In order to read information from an optical disk, a laser beam is focused on the spiral track of pits and the amount of light reflected back into the objective lens is measured. Light striking one of the pits is diffracted (scattered) through such a wide angle that very little finds its way back into the lens. But when the spot is focused on the flat land between pits, most of it is reflected back into the lens. It is the modulated signal produced by this combination of reflected and diffracted light that actually represents the information stored on the disk. The reflected light goes to a photo detector, which produces a current proportional to the light intensity. The reflected light signal thus changes each time the laser beam moves from a pit to land or the reverse. In the case of CD-ROM disk this change occurs through a decoding process called Eight to Fourteen Modulation. The information derived from this varying light signal is converted to digital data usable by a computer. (Figure 5)

One important feature of optical reading in comparison to magnetic reading is that the front edge of the objective lens can be several millimeters from the surface of the disk. This has two ramifications:

- "Crashes" are next to impossible, even with wavy disks and imperfect clamping in the drive. For comparison, the physical clearance between a hard disk head and disk is less than 0.5 μm , about 1/2000 of that of CD-ROM.

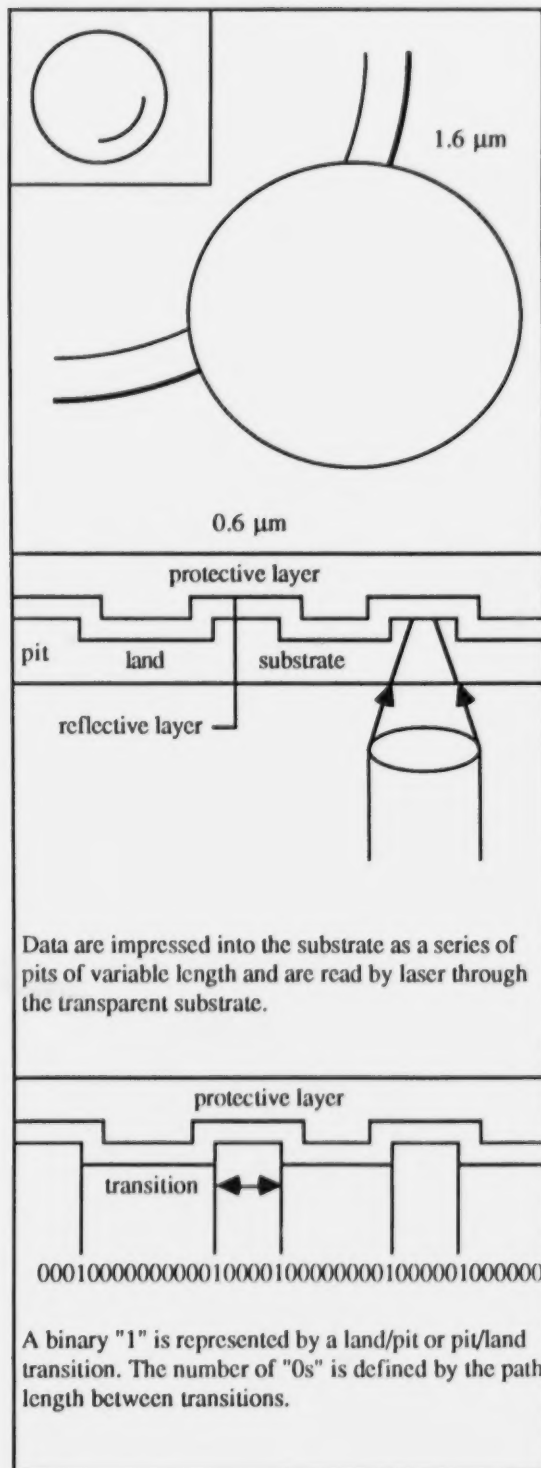


Figure 5. Optical information storage on a CD-ROM disk (according to Philips's brochure).

- Optical drivers send the laser beam through the disk. The information-bearing surface is thus protected by 1.2 mm of tough plastic. Because of the steep convergence of the light coming into the disk, the beam is about 1 mm in diameter as it passes through the outside surface.

2.2 CD-ROM DISK STRUCTURE

2.2.1 Physical characteristics

Let us now examine the macroscopic and the microscopic world of the CD-ROM disk itself. The silvery sheen CD-ROM disk is 120 mm in diameter and has a hole of 15 mm in diameter in the center. It is 1.2 mm thick. The surface of the disk is coated with lacquer. The lacquer layer protects the reflective metal layer, which coats the information surface of the disk. The information the disk carries is molded onto one surface and it is represented by a spiral of microscopical small valleys and planes. The valleys are called pits and the planes are called lands.

The pits are $0.12 \mu\text{m}$ ($1 \mu\text{m} = 10^{-6} \text{ m}$) deep and about $0.6 \mu\text{m}$ wide. The space between the neighbouring tracks of the spiral pattern is $1 \mu\text{m}$. This spacing corresponds to a track density of 16 000 tracks per inch (tpi), that is much higher than the figures associated with a floppy disk (up to 96 tpi) or hard disk (several hundreds tpi). The length of a pit is $0.9 - 3.3 \mu\text{m}$ and the total length of the track on a CD-ROM disk is almost three miles ($3 \times 1.609 \text{ km} = 4.827 \text{ km}$). The total number of pits on a CD-ROM disk is almost two billion. (

2.2.2 Logical layout of the disk

Information track on the surface of a CD-ROM disk, seen under a powerful microscope, is a spiral of 550 MB of pits and lands. The laser and circuitry of the disk drive convert these pits and lands into binary data bits. The binary data are logically divided into sectors and sent to the computer. Each sector contains 2352 bytes of information, of which 2048 bytes are user data. A sector is the smallest storage location on the CD-ROM disk. Each data sector contains the data fields listed in Table 2. (Lambert & Ropiequet 1986; Paris 1986)

Table 2. CD-ROM data fields.

	Mode 1	Mode 2
Synchronization data	12 bytes	12 bytes
Header data	4 bytes	4 bytes
User data	2048 bytes	2336 bytes
Error detection code (EDC)	4 bytes	----
Unused space	8 bytes	----
Error correction data	276 bytes	----

Synchronization data. Sectors are not physically separated. The beginning of each sector is marked with a 12-byte sequence called the sync code. The read head of the CD-ROM drive keeps track of its location on a disk both by counting the number of bytes it passes and by looking for sync information. It uses tracking methods because the synchronization data alone is not enough to establish the boundary between sectors; the same sequence of synchronization bytes could exist in the user data.

Header data. The 4-byte header data identifies the sector. The first three bytes contain the address of the sector. The drive uses this address to locate the sector. The last byte in the sequence is called the mode byte. It indicates the presence of error correction data. Mode 1 includes error correction and detection information. Mode 2 does not include the 280 bytes of error codes and can be used instead to store additional user data.

User data. This is where the information which the CD-ROM disk carries is stored. It can be text, graphics or sound. The so called premastering process divides data into 2048-byte blocks, calculates the error detection and correction codes, and adds synchronization and header information.

Error detection code (EDC). The bytes in the error correction field are used to correct the user data when an error has been detected. A sophisticated algorithm that is based on the Reed-Solomon code is used to correct erroneous data.

2.2.3 Error correction

The data density of a compact disk is tremendous, approaching 100 million bits per square centimeter. With densities this high, even a microscopic defect can cause hundreds

of errors. To avoid errors, the CD-ROM standard includes an error correction scheme to assure the integrity of the data delivered from the disk. (Solomon 1986; Lambert & Ropiequet 1986; Paris 1986)

The CD-ROM drive has error detection hardware that compares the error detection code value to the data as it passes by on its way to the computer. If the decoder detects an error, it signals the computer system. The computer system uses the error correction codes stored alongside the user data to regenerate lost or wrong bits. The codes designed for CD-ROM can take the bit stream coming from a disk in which one in every 10 000 bits is wrong, with bursts of more than 1000 bad bits, and regenerate all but one bit in every 10 quadrillion, or one in every 10^{12} bits. This amounts to about one unrecoverable error in every 2000 disks.

CD audio players have at best a rate of one error in every 100 million bits (10^{-8}). For CD audio this lower rate is acceptable, because the CD audio player extrapolates for missing bits and the ear tends to compensate for the minute sound imperfections an incorrect bit causes. In CD-ROM, however, even a 1-bit error can significantly affect the integrity of the information. For example, an image that is highly compressed from 1 million bytes down to 50 000 bytes could look very different from its original form if 1 bit (representing several bytes of uncompressed data) is not read properly.

Further information about error correction codes for CD-ROM is available from the reference Hardwick, A. 1986. Error Correction Codes: Key to Perfect Data. In: Lambert, S. & Ropiequet, S. (ed.). 1986. CD-ROM: The New Papyrus. Redmond, Microsoft Press. P. 73 - 83.

2.3 PERFORMANCE CHARACTERISTICS

2.3.1 CAV and CLV disks

Most magnetic disks record sectors in concentric tracks, each of which holds a specified number of sectors. By contrast, a CD-ROM disk arranges sectors in one continuous spiral. The different formats relate to the ways the disks spin when they are recorded and read. A magnetic disk usually spins at a constant rate, or constant angular velocity (CAV). A CD-ROM disk spins at varying rate - faster when reading the inner sectors and slower when reading the outer sectors. The CD-ROM disk spins at a constant linear velocity (CLV). A CLV disk rotates so that the data sectors pass the reading head at a constant speed. A CD-ROM drive maintains constant linear velocity by changing the disk's

rotational speed as the head moves along the track. The CLV format of a CD-ROM disk results in sectors having the same length. This kind of format increases the amount of data a disk can store by allowing more sectors at the outer radius, where the circumference is larger. (Chen 1986; Hendley 1986; Isailovic' 1987; Paris 1986)

Although the CLV format is ideal for storing large amounts of data, it is not ideal for retrieving data. The long spiral track makes it difficult to find individual sectors. In addition, each head movement to find a particular sector must be accompanied by the mechanical process of speeding up or slowing down the disk. These drawbacks account for a rather slow data access time for CD-ROMs.

2.3.2 Addressing

A CLV disk requires a different addressing scheme than the more familiar track-oriented scheme of magnetic CAV-disks. An operating system can find a sector on most magnetic disks by using just the track and sector number. In the case of the CD-ROM disk it needs to know the minutes and seconds of linear play time and the sector number to find a sector on disk. An application rarely deals with the physical address of a CD-ROM. It views the data as a group of files, each with an associated filename. When the application calls for a particular file, the operating system takes over. It converts the application's logical view of the disk to a physical view, finding the file's location on disk by using the physical address on CD-ROM.

Good software design must take into account both the strong and weak points of CD-ROM. CD-ROM has its share of both, as do all storage media. Because of the mechanical characteristics of a CD-ROM drive, the access time from one edge of a disk to the other is comparatively long. Therefore, it is important for a retrieval system to avoid unnecessary accesses. The data transfer rate is good, and only becomes a concern when transferring quantities of information such as high-resolution graphics, animation or audiovisual material .

2.3.3 Access time

To read a sector, the head moves to its approximate location and then follows the spiral until it finds the appropriate sector. To read the same sector again, the drive must jump back onto the spiral and wait for the sector to come around again. Since the speed of the disk at outer radius (200 rpm; rpm = round per minute) is less than half of its speed at the

inner radius (530 rpm), reading the outer spirals takes longer than reading the inner spirals.

The *access time* means the time required to locate a particular piece of information on a disk. The term is frequently misused and abused. Its most widely accepted definition includes three events (Lambert & Ropiequet 1986):

- Seek time. The time required to position the head assembly at the desired radius.
- Settling time. The time needed for the head to settle into position at the desired radius.
- Rotational delay. The time the disk must rotate to get the desired sector under the read head.

Seek times on CD-ROMs range from 200 milliseconds (ms) for short distances to 800 ms for longer distances. The seek time of a 5,25" hard disk may be about 30 ms or less. Settling times are shorter, and they depend almost entirely on how fast the read head of a specific drive can be settled on the right position. Rotational delays for CD-ROMs range from 60 ms to 150 ms, compared with 8.3 ms for hard disks rotating 3 600 rpm. Thus, the average access time for a CD-ROM disk drive might be anywhere from 400 ms to 1 sec.

Transfer rate refers to the speed at which the host computer reads data from a disk once the data is found. The transfer rate does not include access time. The CD-ROM's transfer rate is somewhere between that of a floppy disk (31 kB/sec) and a hard disk (625 kB/sec). The more widely used rate of 150 kB/sec involves only the time for transferring the user data, which amounts to 2048 bytes per sector. Data errors can slow down the overall data transfer rate. If an error is detected, the hardware interrupts the data transfer and initiates the error correction process. Only after the data has been successfully corrected will the drive once again begin reading data.

2.4 LOGICAL CHARACTERISTICS

A good physical format of data on a CD-ROM is not enough to make the disk usable. In addition, a logical format is required. The logical format, or file format, makes it possible to view a CD-ROM as a collection of files. This format is constructed from the simpler, sector-oriented view of the disk. By viewing a disk as a group of files, the application can find data by calling a filename. The operating system's file manager looks up the filename in the disk directory and uses associated information to locate the file. Without this high-level view of the disk, the application would have to know the physical location of each

sector related to the file. By utilizing the logical format only the filename has to be known; the file manager does the rest.

The logical format is broken into two distinct structures: the volume table of contents (VTOC) and the directory structure. The VTOC contains information about the disk as a whole, including the location of the disk directory. When the file manager begins reading a disk, it reads the VTOC before anything else. The directory structure specifies the exact locations of the files on the disk. The following characteristics affect the file format design (Lambert & Ropiequet 1986):

- Since CD-ROM disks cannot be changed, the file system need not incorporate a book keeping mechanism to record the locations of used and empty sectors.
- Read-only media allow you to determine disk layout in advance.
- The file system must account for slow access time.
- The applications must be designed around the disk latency period.

2.5 STANDARDS

Compact disk standards began with the CD-Audio product, and the document which specifies the physical and recording characteristics is known as the "Red Book". This was followed by the "Yellow Book" for CD-ROM, which is in effect extended by the "High Sierra Group" proposals for a CD-ROM volume and file format standard. The "Green Book" will specify CD-Interactive. Standards are needed in three different formats: the physical format, the logical format and the application format. (Lunin 1988; Stanford-Smith 1987; Frank 1987; Ropiequet 1987; Schwerin 1986)

2.5.1 The physical format

The standard for the physical format pertains to the physical size, including diameter, thickness and center hole dimensions, as well as the recording density, including the layout of tracks, and the manner in which pits are arranged in the tracks. Related to this is the rotational speed, which gives the data transfer rate and affects the access times. The physical format defines how data is segmented on media, in blocks which have physical addresses, with defined space within the block for user data and overhead for error correction codes. The physical format also involves the modulation and error detection and correction schemes, as well as elements of disk and player manufacture. The physical format is the first area of standards published for CD-ROM, with the Philips and Sony specifications detailed in the "Yellow Book".

There are two areas where standards are critical: Interface standards defining suitable drive - processor combinations and structural standards, which will govern how data is organized on a CD-ROM disk and hence how it can be addressed by a range of operating systems. Looking at Input/Output (I/O) hardware there is a choice of using the PC-BUS de facto standard for connection to IBM PCs and compatibles or the versatile Small Computer Systems Interface (SCSI) which allow connection to a range of other processors but at a small premium in terms of the cost of the drive. On the software side there is now the Microsoft driver interface, MS-DOS Extensions CD-Link, for CD-ROM.

2.5.2 The logical format

There are several groups involved in the formation of a CD-ROM logical standard:

- The High Sierra Group
- The Information Industry Association (IIA)
- American Library Association/The Library and Information Technology Association
- The Optical Disk Forum
- American National Standards Organization (ANSI).
- National Information Standards Organization (NISO)
- International Standards Organization (ISO)
- European Computer Manufacturers Association (ECMA)

The standard for the logical format has to do with how information is conceptually or logically represented on the media. The logical format covers information organization conventions, such as certain properties of volumes, files, records and other data elements and how they are organized with directories, path tables, etc. The standard defines how the information stored on the disk can be used by computer operating and file systems, and how the volume and file structure relates to the physical blocks.

Presently there is a High Sierra/ECMA/ISO standard for defining how files are organized and laid out on a CD-ROM disk but it does not define the contents of the files. However, the format of how text pages, graphics, pictures etc. will be represented and stored on CD-ROM has not yet been standardized. It is most likely that solutions provided by industry leaders such as Microsoft will be used as a de facto standard.

2.5.3 The applications format

The standard for the applications format relates to how information elements, whether text, sound, pictures or program code, are represented within the logical and physical conventions. These specific issues vary considerably from one application to another, and are an area of intensely creative development. Software suitable for search and retrieval of textual information may be entirely unsuitable for pictures or interactive products, because of the differences in data presentations. The applications format was considered in formulating a useful proposal for a logical format standard, but the applications format itself has not been a target of standards formulating work by any party so far.

3 EQUIPMENT NEEDED TO RUN CD-ROM

Most PC (personal computer) -based CD-ROM workstations are designed to be used by one person at a time. Such a system typically contains:

- IBM PC-XT, IBM PC-AT, or compatible, Macintosh or Apple II type of microcomputer,
- usually at least 512 kB of random-access memory (RAM),
- device drivers,
- two floppy disk drivers or a hard disk ,
- a CD-ROM drive (see Appendix 1),
- a CD-ROM drive controller or SCSI (Small Computer System Interface) host adapter,
- some type of an input device (keyboard, touch screen, mouse, joysticks or trackballs),
- a display and respective control card required by CD-ROM application and
- a printer.

The connection between the CD-ROM drive and the microcomputer consists of an adapter card, device driver software in the microcomputer and a cable that connects the CD-ROM drive to the computer. Many recent CD-ROM drives contain their own controllers, which can communicate with the standard high-level interfaces such as IEEE 488 (Institute of Electrical and Electronics Engineers) or SCSI (Small Computer Systems Interface). Both IEEE 488 and SCSI are drive-independent interfaces (Dulude 1986; Laub 1986). Before using CD-ROM the system must be installed. Installation sets the software to user's system configuration - that is, to the operating system version and the type of CD-ROM drive you are using. Unfortunately the installation process differs from one CD-ROM product to another.

CD-ROM drives can be divided into four categories: stand-alone drives, built-in drives, multidrives and jukeboxes. The price of one CD-ROM drive varies between the different models from US \$ 600 to US \$ 1700. Appendix 1. lists CD-ROM drive models, company information, drive configuration and interfaces available (Stanford-Smith 1987; Desmarais 1988).

3.1 STAND-ALONE DRIVES

Stand-alone CD-ROM drives come with their own power supplies and housings. Such a freestanding drive gets its power directly from a wall socket. It is connected to the microcomputer through a standard external interface or through a special device interface

card installed into an expansion slot of the microcomputer. The stand-alone drives are popular for the following reasons:

- availability, since these drives usually are based on commercial CD Audio players,
- simple interfacing and
- easy to move from one place to another. (Figure 6)

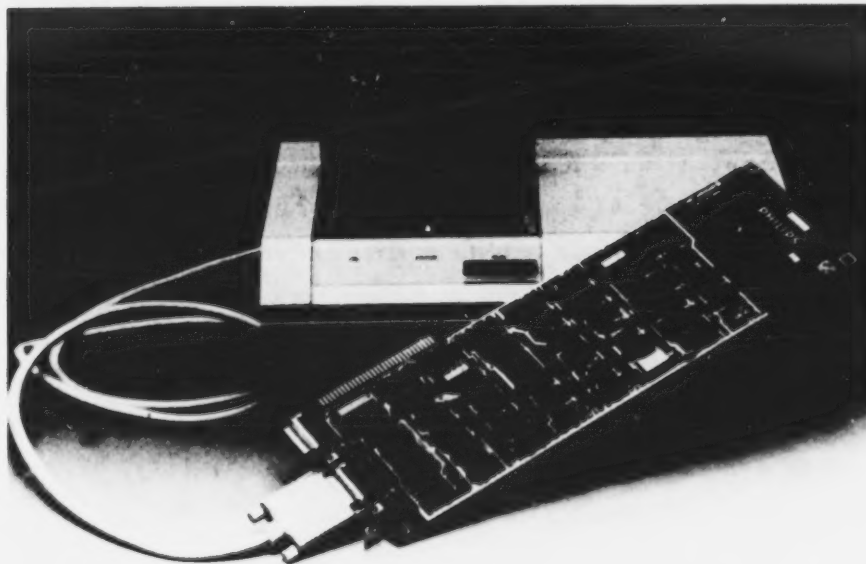


Figure 6. Stand-alone CD-ROM drives.

3.2 BUILT-IN DRIVES

More recently, manufacturers have started supplying CD-ROM drives that can be installed inside microcomputers in the same manner as floppy disk and hard disk drives. The first generation of built-in CD-ROM drives uses standard, full-height, 5.25" design, but more recent models fit into half-height space and can be used also in the newer, smaller desktop and portable computers (Figure 7). A portable computer with a built-in CD-ROM drive is easy to carry from place to place by one person. It is good to notice that if the user wants to print out some information from the CD-ROM disk he must carry the printer also or the printer must be onsite.

The portables use one of three types of displays: CRT (cathode ray tube), LCD (liquid crystal display) or ELD (electroluminescent displays) (Dubash 1987; Stobie 1988). The most common used display for portable computers is the reliable, flexible and easy to use CRT. Most users are familiar with it. Its primary disadvantages are a bulky shape and high power consumption. The CRT itself must be protected from harsh environments. A CRT display can be used under poor lighting conditions. Given a monitor with sufficient resolution it is possible to display any type of image, including color.

The LCD display is small and requires little power. The LCD's response time is slower than that of a CRT display. The LCD bit-mapped graphics are at best crude because the individual picture elements (pixels) are not small enough to give sharp definition. At temperatures below freezing the LCDs may slow down even more or stop altogether.

ELDs combine the advantages of the CRT and the LCD. They can display a full 80 characters by 24 lines, offer good bit-mapped graphics resolution. Their flat shape makes them ideal for portable applications.

3.3 MULTIDRIVES AND JUKEBOXES

A microcomputer system can be constructed to handle several CD-ROM disks. This can be done by using either a multidrive or a jukebox. A multidrive consists for instance of four CD-ROM drives. Presently a couple of models like this are available. A jukebox operates similarly to a jukebox for phonograph records. A jukebox requires a device interface and software to communicate with the operating system and application software in the computer. These together instruct the jukebox to pick up the correct disk and to put it into the CD-ROM drive. To reduce the swap time of disks in jukeboxes it is possible to

incorporate several CD-ROM drives in the jukebox so that you can load disks containing data likely to be called. Such multidrive jukeboxes are not yet available.

In principle it is possible to share one CD-ROM disk among many users. For instance, as local area networks (LANs) connecting PCs become more common, we can expect CD-ROM servers to be installed on the networks along with print servers and file servers. Compared with individual workstations, each equipped with a reader, a network eliminates the need to dedicate a workstation to each disk or to shuffle disks as users need them. Disk handling can be eliminated once there are as many drives in the configuration as there are available disks (Malone 1987; Parti et al. 1988).

Sharing a CD-ROM drive among many users has a serious drawback: it can be used only by one user at a time, the others have to wait for their turn. Presently, different kinds of queuing procedures are under development. The same limitation is when CD-ROM drive is connected to minicomputers or mainframes. The CD-ROM system is designed for PC environment and thus it serves best single-user systems. Also, there is the fact that some suppliers will not allow networking with their products.



Figure 7. Built-in CD-ROM drive.

4 SOFTWARE FOR INFORMATION SEARCH AND RETRIEVAL FROM A CD-ROM DISK

The large storage capacity of the CD-ROM has generated a need for sophisticated search software capable to handle large files. Software previously developed for mainframe computers, as well as those for videodisk applications, information retrieval of textual files on IBM-PC's, online information access and other applications have to be modified for the CD-ROM applications. An end-user requires easy-to-use applications software. He is not interested in the details of the disk's physical data structure.

The needs of an end-user rather than those of information providers have strongly influenced the design of search and retrieval software for CD-ROM. Users are becoming accustomed to gaining convenient access to numeric, graphic and textual information at their workstations; to have the time to browse without high telecommunications costs, to add notations and to download relevant data to floppy disks, to a printer or to another computer. Eventually, the ability to retrieve data electronically will become a skill as common and as important as the use of a telephone is today, and software to support these needs will be developed.

A number of firms are already able to supply software needed to build, and retrieve information from a database on CD-ROM. A comparison of search programs can become complicated because software developers have many different starting points, for instance:

- software has been created in the mainframe environment and then converted to perform the retrieval functions in the microcomputer environment,
- software has been developed for retrieving digital data stored on an analog videodisk,
- software has been designed for full-text searching of the CD-ROM medium,
- some programs are database management systems, and finally
- companies in the online services industry have adopted their searching capabilities and unique interface requirements to CD-ROM retrieval. (Ropiequet 1987)

In most cases the search and retrieval software is stored on the floppy disk for at least two reasons:

- CD-ROM database and the search and retrieval software are two different products usually produced by two different companies, so it is convenient to keep them apart partly because of the copyright reasons,
- when the search and retrieval software is stored on the floppy disk it doesn't take space on the CD-ROM disk.

The development of search software is one of the main steps required to bring a CD-ROM product onto the market. The basic steps in the retrieval process are:

- defining the document,
- defining the search terms and
- creating the retrieval logic.

The retrieval software has to follow these steps and it also has to be designed to take into account the following aspects:

- the type of data in the database (e.g., text only or text combined with graphics, photographs, audio, and/or numerical data).
- the type of source document (machine-readable tape, paper, microfiche, film or videotape) and
- how the end-users will want to use the information

The main trend in the CD-ROM software packages is that every CD-ROM product has its own search and retrieval software. Many softwares are based on the Boolean logic and are quite easy to learn and to use. Some general search capabilities of CD-ROM software are listed as follows (Helgerson 1986a; Helgerson 1986b; Zoellick 1986):

- page-by-page search
- number search
- Boolean operators
- use of parentheses
- thesaurus capabilities
- single character wildcard prefix or suffix
- multi-character wildcard prefix or suffix
- number of hits per document
- number of documents containing hits
- highlighting of hits
- Can the retrieved text be selectively saved to disk files or printed?
- Can results of a wildcard search be easily moved (without retyping) into retrieval search expression?
- Does the search software maintain a log of retrieval responses?
- Is there a user-definable noise word list?
- Is a query library (save & reexecute) available?

Appendix 2 lists the CD-ROM search and retrieval software packages (Churchill 1987; Helgerson 1986)

5 PRODUCTION OF A CD-ROM - FROM DATA TO PITS AND BACK

The move from a conventional database to CD-ROM clearly involves an investment of time and other resources on the part of the database publisher. However, this can be minimized by using various professional services that are already available to handle the essential stages (Appendix 4) (Bowers 1986; Desmarais 1988). The CD-ROM production costs ranges from US \$ 7 000 to US \$ 24 000 and the production process takes time from about three weeks to three months depending on the type of the original data.

The production process of a CD-ROM disk consists of several different phases outlined in Figure 8 (Myers 1987; Curtis 1987). In the following, these phases are shortly described. Items marked with two asterisks (**) are fully covered by the CD-ROM standard; those with one asterisk only partially (Lambert & Ropiequet 1986; Ropiequet 1987).

• **Idea seeking process** i.e. indentifying a CD-ROM product. According to Hatvany (1986) the following criteria should be considered before converting data to CD-ROM:

Is the information needed available ?

What is the volume of data ? It should be at least 150 MB.

How often does the data need to be updated ?

Who will buy the CD-ROM product ?

Why will they buy it ?

Are there enough buyers at the right price ?

Will the data fit on one disk or more disks in the right way ?

In what ways is CD-ROM better and worse than paper ?

In what ways is CD-ROM better and worse than online services ?

How does your potential customer get the CD-ROM ?

Can you educate them to perceive the advantages of your proposed product ?

Is your information source reliable ?

Can you identify prospects cheaply enough ?

Can you support your customers ?

Do you produce yourself the CD-ROM disks or do you have disks produced elsewhere ?

Will the CD-ROM product open up new market opportunities for you ?

• **Data capture.** The data to be published on a CD-ROM disk must be collected somehow.

• **Data input** by keying the data in or by scanning it optically.

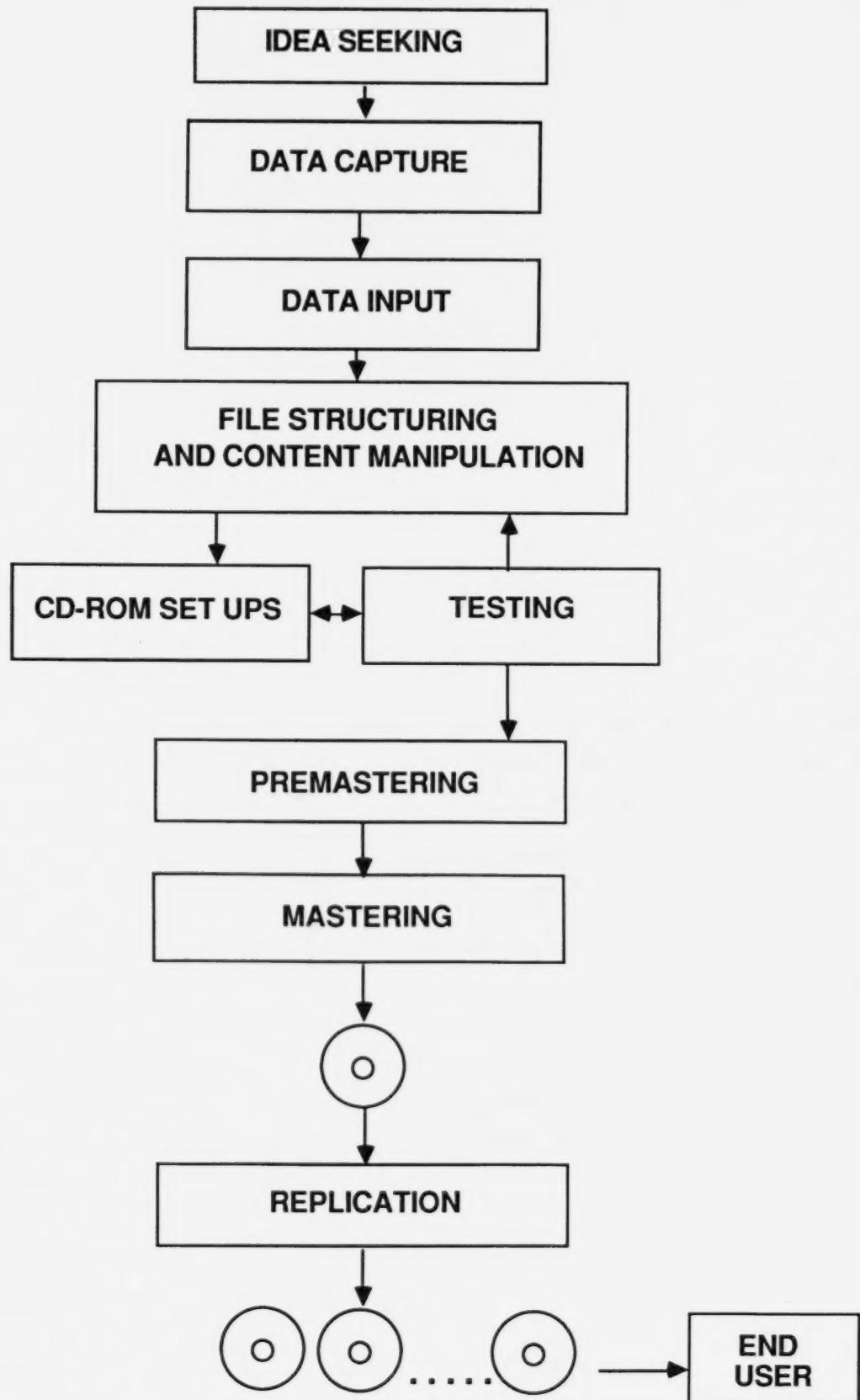


Figure 8. CD-ROM production chain.

- **File structuring.** Material must be organized in such a way that access times are as short as possible. Thus, for example, frequently required data is arranged so that it can be located close to the middle of the recorded track. Where databases already exist in digital form, this is done by specific software.
- **Content manipulation.** Several procedures are needed to combine, check, and correct the data. These procedures are not CD-ROM specific, but rather are standard practice in normal database software.
- **CD-ROM set ups** include index creation, data compression, disk geography creation and data encryption. Because of the large storage potential of CD-ROM, it is important to set up efficient methods of indexing and retrieving the required information - again this is done by appropriate software.
- **Application testing.** At this point the CD-ROM product has to be tested for functionality, access speed and readability. Testing can be done in three ways: with either the glass master, or high speed testing, or CD-ROM simulation facilities.

Testing with **glass master** is slow and costly, and thus it is not recommended. Testing should be done using magnetic simulation.

High speed testing is done at the full speed of a hard disk. It is worth while noting that test results concerning access speeds are not truthful, because the access speeds of the hard disks are often as much as five times that of a CD-ROM. High speed testing gives an estimate of the accuracy of the index and can be used to compare different retrieval software packages.

The third and best way is **CD-ROM simulation**. Simulation makes a hard disk operate like a CD-ROM. The results of simulation tests may enable the developer to determine the need of data compression, to change disk geography, to use interleaved files, or to try another retrieval program.

- **Premastering** (at the database publisher's office or at a service bureau) covers indexing (or reindexing), organization (or reorganization), reformatting (possibly with some ECC = error checking codes) and transferring to nine track tape **. Premastering is a process to generate a set of computer tapes containing all the information to be put onto a CD-ROM disk. The output tapes of premastering process are sent to the mastering facility.

- **Mastering** (at a disk factory) includes error correction coding **, layered ECC **, CIRC = cross-interleaved Reed-Solomon code **, channel encoding (bytes turned to binary signal) **, master recoding (binary signal turned to pits) **. Getting data converted from its raw form to the pits and lands of a CD-ROM disk involves a process known as mastering. In this process the waveform carrying the coded information is transferred from magnetic tape to a modulator. The modulator controls a powerful short-wavelength laser beam as it passes through a lens, forming a spot on the photoresist coating of a glass master disk. The lens moves radially while the master disk spins, so that the information is laid out in the spiral track characteristic to CD-ROM. When the photoresist is developed, it turns the exposed region into pits. The developed master has exactly the surface profile which each usable CD-ROM disk should have.

That profile is copied, either by electroplating or photopolymer replication, onto one or more physical negatives. These "stampers" are used to form the actual disks sold to users. The transfer is usually done by injection molding, although several novel techniques, based on etching or cold embossing, are in pilot production. The material used in all processes is polycarbonate, a transparent plastic also used to make bulletproof windows and eye shields for racing helmets.

- **Disk replication *** for volume production.
- **Reading** (in user's system) i.e. optical reading with a laser beam (including servos) *, channel decoding **, error checking decoding *, CIRC *, layered ECC *, interface to user's computer.

Disk contents can be copyrighted in the same way as music records and the written word. Retrieval programs can easily be added to the data disks themselves. However, publishers usually prefer to separate them for added security. Retrieval programs are stored on a separate copy-protected floppy disk.

The unauthorized extraction of data in printed form is as weakly hindered as is the photocopying of a book. But illegal copying of the disk itself would be costly and time consuming. And if the data are transferred onto another medium the user no longer benefits from CD-ROM's inherent advantages.

6 CD-ROM FROM THE USER'S POINT OF VIEW

6.1 ONSITE DATABASE SEARCHING - POTENTIALS AND LIMITATIONS OF CD-ROM AS A SUBSTITUTE AND COMPLEMENT TO ONLINE DATABASES IN DEVELOPING COUNTRIES

Optical information systems are one of the most exciting new opportunities for librarians. These systems widen libraries' opportunity to acquire and provide information. Many libraries have already acquired experiences on one or more optical systems, while others are still either planning or considering whether to purchase such a system. (Desmarais 1986; Herther 1987; Paisley & Butler 1987)

CD-ROM brings the information onsite. If we compare CD-ROM with online information retrieval systems it is quite easy to conclude that CD-ROM will not replace online systems but complement them and only in some special cases substitute searching databases online (Table 3). Online systems will serve users who need a wide variety of databases or who occasionally use one or more databases. They also serve users with the most current information. On the other hand, CD-ROM serves users that constantly reference a specific database or databases containing graphics. CD-ROM is also a suitable medium for databases with rather static information contents. Furthermore CD-ROM serves as information distribution media in cases where telecommunication networks are not available. The CD-ROM disk is easy to mail or carry, and it is easy to access at the user's site.

It is not surprising that libraries and information services have been active in utilizing the information technology, such as CD-ROM and other optical information systems. They have a central role in delivering, distributing and preserving information. At the present moment, many of the databases available on CD-ROM are also offered online. The products cover the following range of topics:

- bibliographical databases with abstracts,
- encyclopedias,
- book, periodical and other catalogues,
- chemical formulae
- drug details,
- postal codes,
- demographic and mapping data systems,
- software distribution and publishing,

Table 3. Comparison between CD-ROM and online databases.

Characteristics	CD-ROM	Online databases
Capacity	550 MB of data is accessible through one CD-ROM drive; multidrives and jukeboxes will offer more in the future.	Most of the online information retrieval systems offer hundreds of gigabytes of data.
Currency	The data on a CD-ROM disk is at least three weeks out of date when it comes.	Most bibliographic databases are updated monthly. News databases are normally updated in real time.
Costs	CD-ROMs have fixed price or they are available for an annual subscription charge, depending on the product. There are no telecommunication network costs.	Online systems are priced related to the amount of use of the host system and the telecommunication network.
Response time	Those who use online information retrieval systems think that CD-ROM is slow. Information in online retrieval is of course dependent on the remoteness of the host. The CD-ROM response time is mainly due to the drive mechanism and the layout of the disk.	
Cross file searching	Not possible.	Possible.
Hours of operation	Unlimited.	May be limited.
Equipment required	CD-ROM drive, computer and interface.	Modem, terminal or micro-computer, disk or printer for data capture, communications software and telephone.

- in-house publishing and
- on-demand information delivery.

Appendix 3 lists about two hundred CD-ROM databases (Churchill 1987; Nelson 1987). Analysis of the CD-ROM databases in Appendix 3 shows that the first wave in developing CD-ROM applications has concentrated on products for intermediaries rather than for end-users (Figure 9). The second wave will be toward full-text end-user products such as (Figure 10):

- dictionaries,
- telephone directories,
- legal texts,
- instruction and service manuals,
- atlases, and
- navigation systems.

The products in the near future will have special features such as mouse driven access, textual databases with graphics, links with other software (e.g. word processing), integration of CD-ROM and online databases. (Walsh 1987)

A major part of the CD-ROM products is updated monthly or quarterly, but there are some products, such as the one containing public domain software, which are hardly updated at all. Monthly services are becoming more common. (Table 4). The prices of the CD-ROM products range from US \$ 100 to US \$ 27 000. The middle price products range from US \$ 2 000 to US \$ 4 000. These are mostly bibliographical databases with abstracts. (Walsh 1987)

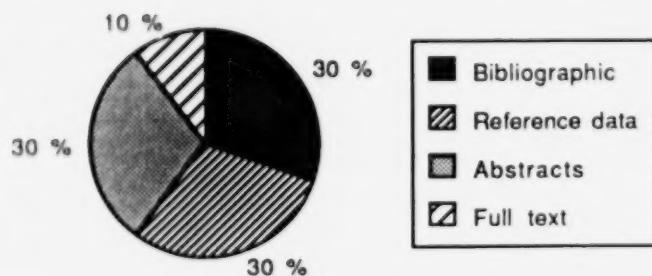


Figure 9. Types of CD-ROM products currently available (Data by Walsh 1987).

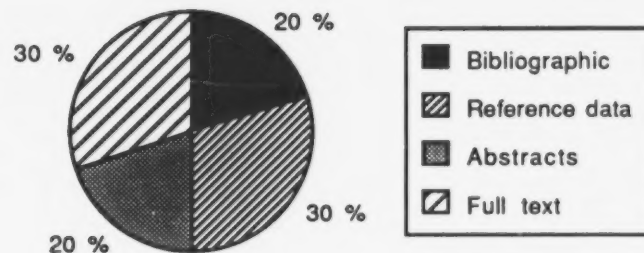


Figure 10. Types of CD-ROM products under development (Data by Walsh 1987).

Table 4. Update cycles for CD-ROM products (Data by Walsh 1987).

Time span	Currently	Under development
Continuously	-	10 %
Weekly	-	5 %
Monthly	12 %	25 %
Quarterly	60 %	35 %
Semiannually	12 %	10 %
Annually	10 %	10 %
Never	5 %	5 %

There are several references in the literature covering checklists how to evaluate and select CD-ROM databases (Cohen & Young 1986; Littlejohn & Parker 1988). For example, Littlejohn's and Parker's list of criteria for evaluating compact disks contains the following parts, the number of questions is presented in parentheses:

CD-ROM evaluation check list (78)

- hardware (7)
- software (25)
- product content (11)
- program management (14)
- ease of use (9)
- vendor support (12)
- CD-ROM student evaluation (9)

- library evaluation of CD-ROM (4)
- product evaluation (7)

According to Peters (1987) a checklist of the CD-ROM product features relevant to most libraries, information services and also end-users should include questions like:

- What are the subscription costs of CD-ROM compared to the costs of direct online searching?
- Does the database have to be returned ?
- Can the user easily move from CD-ROM mode to online mode ?
- Is there a similar information search and retrieval language across all the CD-ROM databases coming from the same publisher ?
- Are there help screens available on the CD-ROM disk and can they be accessed while searching ?

CD-ROM disks could be utilized in several ways in the developing countries. A straightforward application is to purchase databases on CD-ROM disks and use these disks through a local computer for information search, process and storage. This can be done centrally or decentrally in the country. For those countries who have no access to online databases through telecommunication networks, a "National Information Centre" or "Regional Information Centres" can be established. For centres like these databases on CD-ROM disks could be purchased. Other libraries will have access to this information by telex or telephone. Hard copies of relevant material which is not held by their libraries can be ordered from document supply centres in developed countries, e.g. British Document Supply Centre. A careful analysis of the database need should be made. It is worthwhile reducing duplication of the same CD-ROM databases within the same area. Developing countries whose economic resources are minimal, might seek financial support from international organizations like UNDP, UNESCO, US-AID and British Council. (Nazim 1987; Metcalfe & Jones 1987)

The next seven chapters 6.2 - 6.8 are based on the article "Installing CD-ROM systems: How do we do it?" written by Dan Marmion in the CD-ROM Librarian journal (volume 2, number 6, 1987), but also on the experiences obtained in VTT's Information Service and some other libraries in Finland.

6.2 THE ACQUISITION PROCESS AND INSTALLATION OF THE CD-ROM WORKSTATION

The minimum installation of a CD-ROM system consists of a microcomputer, a CD-ROM disk drive, the means to interface the two and software to run the system. Presently the compatibility is less of a problem than it was just a short time ago. Disk drives can be connected to most IBM PC based or compatible microcomputers, and the disks manufactured according to the High Sierra standards should work on most CD-ROM disk drives. What is still a problem is that the way in which the data is actually stored on the disk varies greatly from one producer to another as does the search language of the database. Because of these differences the systems do not work in the same way.

Libraries have to decide whether:

- to limit involvement in optical systems to only one or two products with maybe a separate workstation for each or
- to build a large collection of incompatible disks/systems.

It is unlikely that many libraries will be able to provide a separate workstation for each system. This means that users have to exit from one program back to operating system level and load a new set of search software into the computer's memory along with putting a new disk in the CD-ROM drive. The process can be simplified by storing the different search software and drive configurations on the hard disk. A menu for the selection of the desired CD-ROM application can be created.

When purchasing a system one often has the choice of either buying hardware that is offered together with the CD-ROM product or acquiring it separately from a dealer of choice. This applies especially for those who have a local dealer who may provide substantial discounts. It has to be remembered that the joined hardware is guaranteed to work properly with the system while it is up to the individual library to make sure that equipment purchased separately will work with various CD-ROM applications and that it includes all necessary parts such as controller cards for the disk drives. For example, problems with an IBM compatible microcomputer may occur; the software does not work correctly and it has to be sent back to be fixed.

The quality of hardware must be high enough. It is not worth having a good CD-ROM product if the hardware is constantly crashing. When the system is frequently down it is not the hardware that gets a bad reputation among the users, but rather the name of the CD-ROM disk. In the case that hardware will crash, it should be found out in advance what kind of support your dealer will provide. If the hardware is acquired from the

producer of the optical system they will generally accept responsibility for the equipment; it is to their advantage to keep the system running. On the other hand if you acquire the hardware yourself you also have to be able to acquire the maintenance.

6.3 COMPOSITION AND LOCATION OF THE CD-ROM WORKSTATION

The composition of the CD-ROM workstation will be determined by the purpose of the system. A microcomputer and a CD-ROM disk drive are two required components but other peripheral devices can vary according to the particular situation and might include one or more of the following:

- additional floppy or hard disk drives,
- a modem for online searching to complete the retrieval from a CD-ROM disk,
- telefax equipment and a scanner for document delivery to borrowing libraries,
- a printer, etc.

The location of the CD-ROM workstation depends on the use to which it will be put but there are also some other aspects to be considered. If a library plans to buy, for example, the NTIS database on disk, and can only afford one copy:

- Should this copy be placed in the public services area or in the technical services?
- Should the access be made convenient, in the first place, for the patrons or for the staff?

The cost factor must also be taken into account. CD-ROM workstations can be located in the same space where online searching is made so the same printer can be used for both computers. A workstation requires at least 30 - 40 ft² (2.8 - 3.7 m²) of space.

To guarantee the security of the public CD-ROM workstation, it is good to purchase lockable covers or cabinets for the equipment or buy very long cables and keep the computer and drives in a secure area, leaving only the monitor and keyboard to the public. The public workstation should be placed in an area where it can easily be observed, for example from the reference desk (Figure 11). The equipment should be locked up at night.

Because of the small size of CD-ROM disks they might be subject to theft, particularly if a library has several products available to the public. The floppy disks containing the CD-ROM application program can also be stolen from the drive as well. If possible the program should be loaded to the computer memory in the morning and the disk itself should be removed. If the application program is stored on the hard disk such a problem

does not occur. In an open system patrons may be able to put their own disks in the floppy drive, print their own materials on the library's printer and paper, run their own programs in the computer or load them on the hard disk. All this should be forbidden and made impossible. Also patrons should not be able to modify the routine that keeps statistics on who has used the system.



Figure 11. CD-ROM workstation at the Information Service of the Technical Research Centre of Finland (VTT).

6.4 MAINTENANCE OF THE CD-ROM SYSTEM

An important issue to consider is that of maintenance. Computers, drives and printers will occasionally need to be serviced. In the case that the equipment was acquired together with the CD-ROM product then the producer may be responsible for the repair or replacement during the time of warranty, but it is essential to make certain of this in the beginning. The library is responsible for maintaining any equipment it provides and it is

better to consider a service contract with a local dealer. Some university libraries may take advantage of the campus repair facilities.

Staff members should be familiar with some aspects concerning both the equipment and the optical systems. They should know

- how to reboot the system when it crashes,
- how to clear the printer when paper gets jammed,
- how to change ribbons or ink cartridges,
- how to load paper into the printer and
- whom to contact when more serious problems occur.

One option is to appoint someone to take care of routine maintenance matters. Some libraries use student assistants to monitor the system, check out disks and maintain workstations.

6.5 ECONOMICS OF CD-ROM

Most of the present CD-ROM products are slightly modified versions of existing databases (Churchill 1987; Anon 1988). Some specialized products, e.g., demographic databases, maps on CD-ROM and databases with text and graphics, such as International Encyclopaedia of Education, have appeared lately. It is understandable that publishers are still learning how to produce and market these products and, consequently, the pricing is still unsettled. As the time goes by the producers gain more experiences in this relatively new industry and hopefully as a result of this the price structure will stabilize. One thing that will affect the prices in future is the degree to which libraries continue to purchase the information sources in the print and/or microfilm formats. If libraries actively transfer from the older formats to the optical format then producers will adjust prices accordingly. It is good to keep in mind the following aspects:

1. It is advisable to keep the capital investment in the hardware separate from the investment in the CD-ROM product, because although the initial investment for the equipment is sizable, much of it will retain its utility even if the library decides to discontinue purchasing a particular optical system.
2. Massive use of the CD-ROM makes the per-search cost much lower in comparison to the online searching where each search accrues costs independently of previous searches. A library may even find that it is able to provide more information to more patrons for a given amount of money than before.

Some manufacturers of optical products offer discounts on quantity purchases of their system. While it is not likely that an individual library will be able to purchase sufficient quantities of a particular product to obtain a volume discount, some library networks are entering into arrangements to guarantee a certain number of purchases. The networks are then able to deliver the products to individual libraries at discounted price.

For the budget the cost on paper and ribbons or ink cartridges should also be taken into account. Users love to print!

The financing of the system is often a problem to the libraries. Each library has to find their own solution but here are some examples:

1. Grant money - a library covers the initial subscription through a grant and when the grant expires they have to find other ways of financing.
2. One library used money that had been allocated for an other workstation.
3. Many libraries use funds from acquisitions or book budgets.
- 4 One library received extra funds from their university to purchase new technology products.

A serious question is, should the library try to cover all or part of the cost by charging for the service? This subject is controversial. One opinion is that if the traditional free sources of information are also available in the library there should be no objection against charging patrons for the convenience of the optical product. The libraries have to consider whether they continue purchasing the printed version when they have the corresponding CD-ROM product.

6.6 WHO WILL USE THE CD-ROM SYSTEM?

The large variety of CD-ROM systems and products serve various kinds of users. Firstly there are true end-user systems. These are generally easy to use, menu-driven and do not involve Boolean searching. Next, there is a much larger group of products that are more complicated to use. They usually provide Boolean searching and are command-driven although some have an "easy mode" that uses menus. They are meant for at a broader group of users, including students, researchers, library staff etc. Finally there are some "high-level" products comparable to certain online services that are very complex. They are meant for professional users and information intermediaries.

6.7 TRAINING AND EDUCATION OF THE USERS

Once the selection has been made, the equipment acquired, and the first disks are in place and ready to go, will the user be able to use the system instantly? Or will it be necessary to provide some training or tutorials? The answer depends to a large extent on the specific system chosen. InfoTrac system, for example, is very "user friendly" and requires no real training to learn to use. It contains online help screens for those who need them, but most people are able to search the system and find what they need with very little or no help.

Some products may be more complicated and require the ability to formulate a Boolean search strategy. In such a case it may be necessary to provide some type of end-user training. This can be arranged by giving written instructions that are available at the service point or by providing training seminars on database searching.

For example, computer based tutorials that include interactive testing or workbooks can be used. Also, the patrons may be asked to complete a tutorial and submit their strategy to a librarian for review before they are allowed to proceed with their search. In addition to training, it probably will be necessary to inform the user about the content of the CD-ROM database. The content of the CD-ROM database should be clearly marked somewhere on the system.

6.8 RULES FOR USING CD-ROM SYSTEM

The experiences of several libraries have shown that optical systems are very popular among their patrons and that, in many cases, people will wait in line to use them rather than use traditional printed or microfilm sources. Many libraries have been forced to formulate rules for the use of the systems by setting time and print limits for a search session. This can be arranged by posting a sign requesting patrons to confine themselves to X number of minutes and/or Y number of printed citations. The optimum amount of time may vary from product to product. One library had a half-hour limit set but found that it really wasn't enough time to complete the search. Some libraries have set up an advanced booking system for their CD-ROM usage.

7 FUTURE TRENDS

7.1 THE CD FAMILY EXPANDS

The compact disk technology will have strong effects at the office, factory and home. It is a very progressive field of research. It seems that there is always a new solution just around the corner. New formats appear constantly. As with any emerging technology, the market is volatile and will remain so for some time. Compact Disk Interactive (CD-I), Digital Video Interactive (DVI) and Compact Disk Video (CD-V) have been issued recently. Most of these technologies are not yet on the market. (Desmarais 1988; Morris 1987; Philips International 1987)

CD-I technology incorporates text, graphics, digital audio and still frame video from a single CD-I disk. It is both a medium and a total system. The new multi-applications-based CD-I system is aimed for the home market as well as for professional users. CD-I applications can be categorized as follows:

- education and training
- entertainment
- creative leisure
- work at home/while traveling
- navigation.

The competing technology to CD-I is the digital video interactive technology (DVI). It has the ability to display up to one hour of full-motion video from compressed digital data stored on a single, standard CD-ROM disk. DVI's motion video can be combined with foreground video objects, text, 3-D graphics and multitrack audio, all under the user's control. Application areas of DVI are as follows:

- training
- retail
- simulation
- education
- entertainment/consumer.

CD-V is a combination of the CD-Audio and analogical videodisk. There are three different sizes of the gold-colour CD-V disks. The 5" disk is aimed at the popular music market, with 5 to 6 minutes of video with digital audio, and 20 minutes digital audio. The 8" product provides 20 minutes of video and digital audio per side, while the 12" disk provides a total of 60 minutes per side. CD-V disks are linear media.

7.2 HYPERTEXT

Hypertext systems feature machine-supported links - both within and between documents - that open exciting new possibilities for information retrieval. The concept of hypertext is as follows: Windows on the display screen are associated with objects in a database, and links are provided between these objects, both graphically and in the hypertext database (Figure 12). Hypertext system has the following central aspects (Conklin 1987):

- The database is a network of textual nodes which can be thought of as a kind of hyperdocument.
- Windows on the screen correspond to nodes in the database on a one-to-one basis. Each node has a name or title which is always displayed in the window.
- Standard window system operations are supported.
- Windows can contain any number of link icons which represent pointers to other nodes in the database.
- The user can create new nodes and new links to new nodes or to existing nodes.
- The database can be browsed in three ways:
 - (1) by following links and opening windows,
 - (2) by searching the network for some string, keyword or attribute value, and
 - (3) by navigating around the hyperdocument using a browser that displays the network graphically.

The extension of hypertext is the more general concept, hypermedia, in which the networked elements can be text, graphics, speech, audio recordings and pictures. Optical disks are hypermedia.

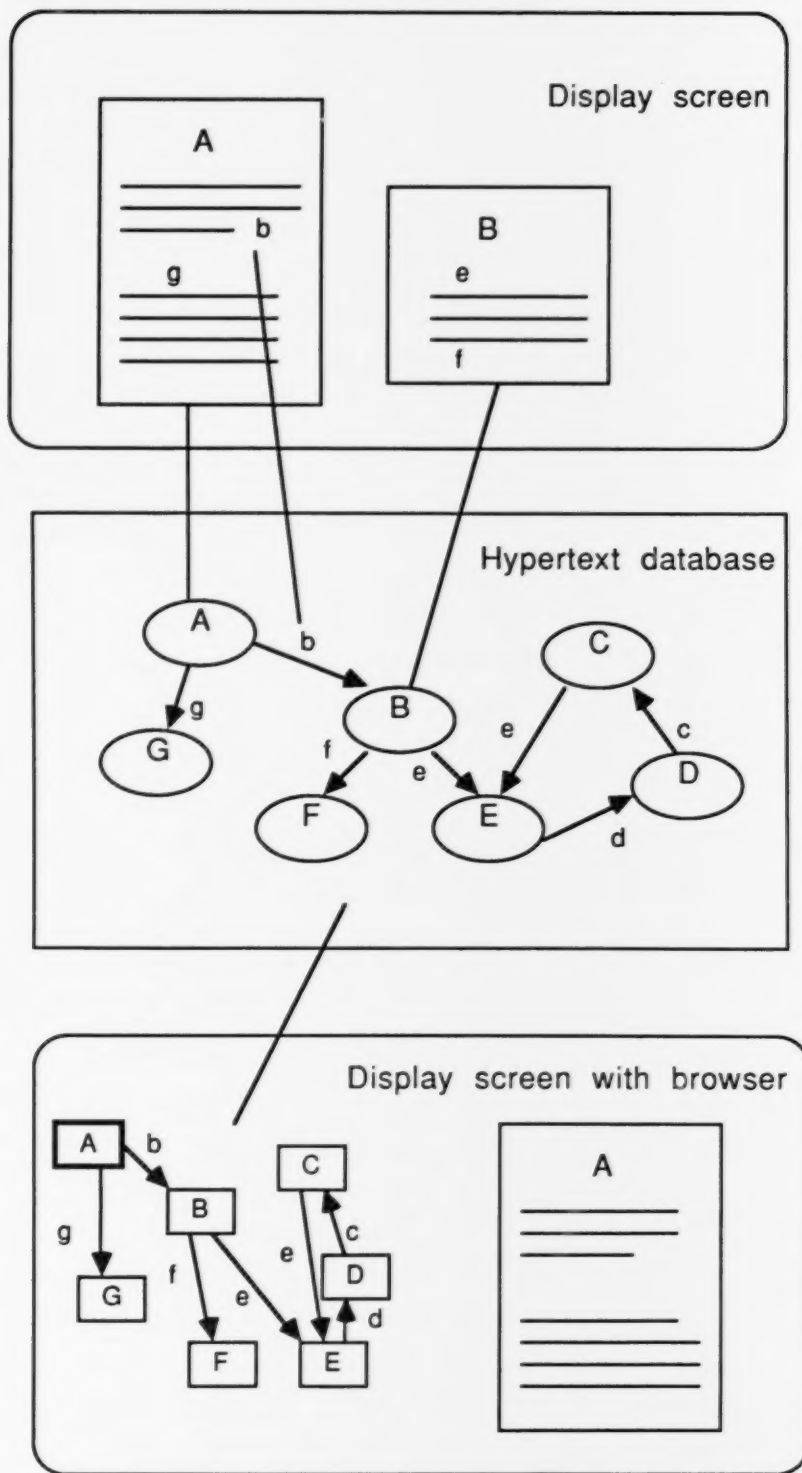


Figure 12. The hypertext document. The correspondence between windows and links in the display, and nodes and links in the database. The hypertext browser provides a graphic view of the underlying database (Conklin 1987).

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CD-ROM DRIVES

COMPANY NAME	MODEL	CONFIGURATION	INTERFACES AVAILABLE
Alot 10 Victor Square, Suite 600 Scotts Valley, CA 95066 USA	LD CD-ROM Drive	Stand alone Front loading	SCSI
Amdek Corp. 1901 Zanker Road San Jose, CA 95112 USA	Laserdrive I	Stand alone Front loading	IBM PC/AT/XT
Apple Computer Inc. 20525 Mariani Ave. Cupertino, CA 95014 USA	AppleCD SC	Stand alone Front loading	DB-25 SCSI port using Apple SCSI cabling
Atari Corp. 1196 Borregas Ave. Sunnyvale, CA 94086 USA	CDAR500	Stand alone Front loading	Atari ST, SCSI to IBM PC
Denon 222 New Road Parsippany, NJ 07054 USA	DRD-550 DRD-250 DRD-251	Stand alone Built in, half height Built in, half height All front loading	SCSI IBM PC/AT/XT SCSI
Digital Equipment Corp. 2 Mount Royal Ave. Marlboro, MA 01752, USA	RRD50-QA RRD50-EA RRD50-AA	Stand alone Stand alone Stand alone All top loading	MicroVaxII VAXmate IBM PC
Hitachi 401 West Artesia Blvd. Compton, CA 90220 USA	CDR-1502S CDR-1503S CDR-1553S CDR-2500S CDR-2500 CDR-3500	Stand alone Stand alone Stand alone Stand alone Built in, full height Built in, half-height All front loading	IBM PC/AT/XT 8-bit parallel IBM PC/AT/XT Digital audio SCSI Digital audio CD-IF25A interface card for IBM PC/AT/XT; audio optional CD-IF25A interface card for IBM PC/AT/XT; audio optional CD-IF35A interface card for IBM PC/AT/XT; audio optional
JVC 41 Slater Drive Elmwood Park, NJ 07407 USA	XR-R100 XR-R1001	Stand alone Built in, half height All front loading	SCSI SCSI
Online Computer Systems, Inc. 20251 Century Blvd. Germantown, MD 20874 USA	N/A	Four drive desktop unit (Sony CDU-5002) Front loading	Online's CDI-110 or CDI-120 controller cards
Panasonic 1 Panasonic Way Secaucus, NJ 07094 USA	SQ-D101 SQ-D1	Stand alone Built in, half height All front loading	IBM PC/AT/XT, SCSI IBM PC/AT/XT, SCSI

COMPANY NAME	MODEL	CONFIGURATION	INTERFACES AVAILABLE
Philips 4425 ArrowsWest Drive Colorado Springs, CO 80907, USA	CM 100 CM 110 CM 201 CM 210	Stand alone, top loading Stand alone, top loading Built in, half height, front loading Built in, half height, front loading	IBM PC SCSI IBM PC SCSI
Reference Technology 5700 Flatiron Parkway Boulder, CO 80301 USA	Clasix 500	Stand alone Front loading	IBM PC
Sanyo 51 Joseph Street Moonachie, NJ 07074 USA	ROM-300 ROM-2500	Stand alone Built in, half height All front loading	IBM PC/AT/XT, SCSI IBM PC, SCSI
SilverPlatter 37 Walnut Street Wellesley Hills, MA 02181 USA	MultiPlatter 4/4	Floor standing system for four simultaneous users, Front loading	N/A
Sony 655 River Oaks Parkway San Jose, CA 95134 USA	CDU-100 CDU-5002 CDU-510	Stand alone Built in, full height Built in, half height All front loading	Sony bus Sony bus Sony bus
Toshiba 9740 Irvine Blvd. Irvine, CA 92680 USA	XM-2000A XM-2000B	Stand alone Built in, full height All front loading	SCSI, digital audio SCSI, digital audio

The price of one CD-ROM drive varies between the different models from US \$ 600 to US \$ 1700.

CD-ROM SOFTWARE PACKAGES

SOFTWARE	COMPANY NAME AND ADDRESS
AIRS/TEXT Software	AIRS, Inc. Engineering Research Centre, 335 Paint Branch Drive, College Park, MD 20742, USA
Bibliofile	The Library Corporation, P.O. Box 40035 Washington, DC 20016, USA
BlueFish	Computer Access Corporation, 26 Brighton Street Belmont, MA 02178-4008, USA
BRS/Search	BRS Information Technologies (Europe), 11 Weymouth Street, London WIN 3FG, England
C/D Search	OCLC, Inc., 6565 Frantz Road, OH 43017-0702, USA
COBRA software	Bertelsmann Computer Beratungsdienst, Heidenkampsweg 44, D-2000 Hamburg 1, West Germany
Dataware indexing and retrieval software	Dataware 2000, GmbH Garmischerstrasse 4-6, D-8000 Munich 2, West Germany
DELVE	Group L Corporation, 481 Carlisle Drive, Heamdon, VA 22070, USA
FIND	Acctex Information Systems, 131 Steuart Street Suite 600, San Francisco, CA 94105, USA
FIND IT	Reteaco, Inc., 716 Gordon Baker Road, Willowdale, Ontario, M2H 3B4, Canada
Ful/Text	Fulcrum Technologies, Inc., 560 Rochester Street, Ottawa, Ontario K1S 5K2, Canada
Full Text Manager	Reference Technology, 5700 Flatiron Parkway, Boulder, CO 80301, USA
INMAGIC	INMAGIC, Inc., 2067 Massachusetts Avenue, Cambridge, MA 02140, USA
KAware	Knowledge Access, Inc., 2685 Marine Way Suite 1305, Mountain View, California 94043, USA
Knowledge Retrieval Software	Knowledge set Corp., 60 Garden Court, Monterey, CA 93940, USA
Knowledge Retrieval Software - the compact solution to words and pictures	Pergamon Compact Solution, 12 Vandy Street, London EC2A 2DE, England

SOFTWARE	COMPANY NAME AND ADDRESS
Master Search™	Tri Star Publishing 475 Virginia Drive Fort Washington, PA 19034, USA
Merge Image/Information Retrieval System (MIRS)	Advanced Image Technology 100 Park Avenue, 34th Floor New York, NY 10017, USA
MicroBASIS	Information Dimensions, Inc., 655 Metro Place South, Dublin, OH 43017-1396, USA
MULTI-FETCH Retrieval Software	Software Mart, Inc. 4131 Spicewood Springs Road, Suite 1-7, Austin, TX 78759, USA
OPTEXT Research and Retrieval Software	VLS, Inc., 5215-11 Monroe Street, Toledo, OH 43623, USA
RESEARCH	TMS Inc., 110 West 3rd Street, P.O.Box 1358, Stillwater, OK 74076, USA
SilverPlatter Search and Software	SilverPlatter Information Services, Inc., 37 Walnut Street, Retrieval Wellesley Hills, MA 02181, USA
Silversmith retrieval	Taunton Engineering, 505 Middlesex Turnpike Suite 11, software Billerica, MA 01821, USA
Sta/F TEXT	Reference Technology, 5700 Flatiron Parkway, Boulder, CO 80301, USA
STATUS	Harwell Computer Power Ltd., Curie Avenue, Harwell , Oxon OX11 0QW, England
Textbank/PC	Group L Corporation, 481 Carlisle Drive, Hearndon, VA 22070, USA
WorkFlo Document Image Processing System	FileNet Corp., 3350 Hyland Avenue, Costa Mesa, CA 92626, USA
ZyINDEX	Zy Lab Corporation, 233 East Erie Street, Chicago, IL 60611, USA

There are also proprietry software packages available, for example LaserQuest and Bookshelf, which do not necessarily use one of the packages listed above.

CD-ROM PRODUCTS

Commercially available CD-ROM products, their vendors and addresses are listed as follows (Tiampo 1987; Nelson 1987; Churchill 1987). Short descriptions of the databases are also given.

CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
ADDRESS VERIFICATION SYSTEM PLUS	T	Information Design Inc. 1500 Charleston Road, Mountain View, CA 94043-7130, USA	Approximately 110 million addresses in the USA.
AGRICOLA	B	Microinfo Ltd. P.O. Box 3 Omega Park Alton Hants GU24 2PG, England SilverPlatter Information Services 37 Walnut Street, Wellesley Hills, MA 02181, USA	Records of material acquired by the National Agricultural Library and cooperating institutions.
AGRICOLA	B	OCLC 6565 Frantz Road, Dublin, OH 43017, USA	See above.
AGRICULTURAL MATERIALS IN LIBRARIES	B	OCLC	The agricultural subset for the OCLC catalogue. The catalogue lists all the publications held by OCLC member libraries.
APPLIED SCIENCE & TECHNOLOGY INDEX	B	H.W. Wilson Co. 950 University Avenue, Bronx, NY 10452, USA	An index of the 335 key English language periodicals in science and technology.
AQUATIC SCIENCES AND FISHERIES	B	Microinfo Ltd.	Information from worldwide literature covering the science, technology and management of marine, brackish and freshwater environments.
ART INDEX	B	H.W. Wilson Co.	Index of 200 periodicals, yearbooks and museum bulletins, published in English and foreign languages addressing important developments in the world of art.
A-V ONLINE	B	Microinfo Ltd. SilverPlatter Information Services Access Innovations P.O. Box 40130, 4320 Mesa Grande S.E. Albuquerque, NM 87196, USA	Database of audiovisual materials from the National Center of Educational Media (NICEM).

CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
BIBLIOFILE	B	The Library Corporation P.O. Box 40035 Washington, D.C. 20016 USA EBSCO Electronic Information P.O. Box 13787 Torrance, CA 90503, USA	The complete Library of Congress machine-readable record catalogue (MARC) on 3 disks.
BIBLIOMED	B, T	Digital Diagnostics Inc. 601 University Avenue, Suite 255, Sacramento, CA 95819, USA	Subset of Medline database.
BIOGRAPHY INDEX	B	H.W. Wilson Co.	References to biographies in current books of biography, autobiography, critical studies and biographical fiction.
BOOKS IN PRINT PLUS	B	R.R. Bowker Borough Green Sevenoaks, Kent TN15 8PH, England	750 000 books in print and over 100 000 forthcoming books that are published or distributed in the USA.
BOOKS IN PRINT WITH REVIEWS PLUS	B	R.R. Bowker	Books in print database with reviews from Publishers Weekly, Choice, Booklist, Library Journal and School Library Journal
BOOKS OUT OF PRINT PLUS	B	R.R. Bowker	400 000 titles that have gone out of print or out of stock indefinitely since 1979.
BUSINESS INDICATORS	T	Slater Hall Information Products J1522 K Street Suite 522, Washington, D.C. 20005, USA	Economic time series covering all aspects of the USA economy.
BUSINESS PERIODICAL INDEX	B	H.W. Wilson Co.	304 essential international English language periodicals in trade and business research.
CAB ABSTRACTS	B	CAB International Wallingford Oxon OX10 8DE, England	Citations to agricultural and related applied biological journals.

CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
CANCER-CD	B	Microinfo Ltd./SilverPlatter Information Services	Citations to medical articles and drug; clinical and pharmaceutical data accessible by trade and manufacturers' name.
CCINFO DISK	B	Canadian Centre for Occupational Health and Safety 250 Main Street East Hamilton, Ontario L8N 1H6, Canada	Citations to 30 000 entries on all aspects of occupational health and safety.
CD-BANKING COMMERCIAL BANKING	T	Sheshunoff and Co. Inc. One Texas Center, 505 Barton Springs Road, Austin, TX 78704, USA	Information on the 14 500 commercial banks in the USA.
CD/BIOTECH	B	PC SIG 1030D East Duane Avenue, Sunnydale, CA 94086, USA	Database of information and software packages relating to biotechnology.
CENSUS OF AGRICULTURE	T, N	Slater Hall Information Products	Statistics and agricultural production, inputs, sales, acreage.
CHEM-BANK	T	Microinfo Ltd./ SilverPlatter Information Services	Three databases of potentially hazardous chemicals.
CIRR - CORPORATE AND INDUSTRY RESEARCH REPORTS	T	Microinfo Ltd./ SilverPlatter Information Services	Cumulative index of over 75 000 company industry reports.
COMPANY ACCOUNTS REGISTER OF THE BELGIAN NATIONAL BANK ON CD-ROM	T	Bureau Marcel van Dijk Rue de Rennes, 106 bis 75006 Paris, France	The annual accounts of every company registered in Belgium.
COMPU-INFO - US COMPUTER REVIEW	T	Microinfo Ltd./ SilverPlatter Information Services	Specifics on 12 000 current computer products from 1 500 companies worldwide.
COMPUSTAT PC PLUS	T	Standard and Poors Compustat Service 7400 South Alton Court, Englewood, CO 80112, USA	Financial information on 7 000 US public companies.

CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
CONQUEST	T	Donelly Marketing Information Services 70 Seaview Avenue, Stamford, CT 06904, USA	A US consumer information database.
CONSTRUCTION CRITERIA BASE	T	National Institute of Building Sciences 1015 15th Street Suite 700 NW, Washington, DC 20005, USA	Government criteria for building design.
COUNTY STATISTICS	T, N	Slater Hall Information Products	Statistics for every county in the USA, with metro-area, state and US totals.
CUMULATIVE BOOK INDEX	B	H.W. Wilson Co.	Information on English language books throughout the world.
DATEXT - CD/BANKING	T	Lotus Development Corp. 55 Cambridge Parkway, Cambridge, MA 02142, USA	Information on Federally-insured commercial banks and savings & loan companies.
DATEXT - CD/CORPORATE	T	Lotus Development Corp	Information on 10 000 US public companies, 900 lines of business, 50 industries and thousands of executives.
DATEXT - CD/CORPTECH	T	Lotus Development Corp	Hard-to-find information on more than 17 000 US high technology companies.
DATEXT - CD/INTERNATIONAL	T	Lotus Development Corp	Financial information on the world's 4 000 leading companies.
DATEXT - CD/NEWSLINE	T	Lotus Development Corp	Information from Dow Jones News/Retrieval.
DATEXT - CD/PRIVATE	T	Lotus Development Corp	Information on nearly 100 000 companies in every line of business.
DISCLOSURE	T	Disclosure Inc.	Financial and corporate information on more than 10 000 US companies.

CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
DISSERTATION ABSTRACTS ONDISK	B	University Microfilms International 300 North Zeeb Street, Ann Arbor, MI 48106, USA Microinfo Ltd.	Information on more than 900 000 doctoral dissertations and masters theses written since 1861 on three CD-ROM disks.
ECCTIS COURSES GUIDE	T	ECCTIS P.O. Box 88 Walton Hall, Milton Keynes, MK7 6DB, England	Information on all further and higher education courses in the UK leading to qualifications.
EDUCATION INDEX	B	H.W. Wilson Co.	Indexes 354 key international English language journals in all areas of education.
EDUCATION MATERIALS IN LIBRARIES	B	OCLC	Subset of the OCLC Catalogue covering educational materials held in the OCLC member libraries.
EDUCATIONAL TESTING DATABASE	T	Minnesota Department of Education Minnesota State Assessment, 725 Capital Square Building, 555 Cedar Street, St. Paul, MN 55101, USA	Testing material on mathematics, social sciences, languages and science.
ERIC	B	Microinfo Ltd./SilverPlatter Information Services	The Educational Resources Information Center (ERIC) database is the national US database covering citations to the literature of education.
ERIC	B	OCLC	See above.
ERIC	B	Dialog Information Service Inc. 3460 Hilview Avenue, Palo Alto, CA 94304, USA	See above.
FAST PAST	T	MicroTRENDS 650 Woodfield Drive Suite 730, Schaumburg, IL 60173, USA	Historical information, 4000 BC to 1945 AD.

CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
GENERAL SCIENCE INDEX	B	H.W. Wilson Co.	Indexes 111 major English language periodicals published chiefly in the US on a wide range of scientific topics.
GEODISK - US ATLAS	G, T	GeoVision Inc. 270 Scientific Drive Suite 1, Norcross, GA 30092, USA	Maps for all 50 states.
GERMAN POST OFFICE CD	T	German Post Office D.F.T.I. 7E P.O. Box 1100, 3550 Marburg, West Germany	A street and place guide corresponding the printed one used in the German Post Office.
GOVERNMENT DOCUMENTS CATALOGUE SUBSCRIPTION	B	Auto-Graphics Inc. 3201 Temple Avenue, Corona, CA 91768, USA	Details of all USGPO publication from 1976 to date.
GROLIER'S ELECTRONIC ENCYCLOPEDIA	T	EBSCO Electronic Information	Full text of the Academic American Encyclopaedia,
HARRAP'S MULTILINGUAL DICTIONARY	T	Microinfo Ltd.	Contains 13 dictionaries including English, German, Spanish, French, Dutch, Italian, Japanese and Chinese.
HUMANITIES INDEX	B	H.W. Wilson Co.	Indexes 294 key English language periodicals on humanities.
HYDRODATA - DAILY VALUES	T	US West Knowledge Engineering Inc. 4380 South Syracuse Street Suite 600, Denver IO 80237, USA	The stream flow data values measuring the discharge of streams throughout the US.
HYDRODATA - PEAK VALUES	T	US West Knowledge Engineering Inc.	Data on minor and major floods.
IMPACT	B	Auto- Graphics Inc.	A public access catalogue from MARC records for the client library.
INDEX TO LEGAL PERIODICALS	B	H.W. Wilson Co.	Indexes 476 leading legal periodicals in English, French and Spanish.
INFOMARK	T	National Decision System 539 Encinitas Boulevard, Encinitas, CA 92024, USA	A business fact, a shopping centre and geodemographic database.

B = Bibliographic, T = Text, G = Graphics, N = Numeric, D = Data, A = Audio

CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
INFOTOOLS	T,B	Learned Information (Europe) Ltd. Woodside, Hinksey Hill Oxford OX1 5AU, England	Contains four databases published by Learned Information Ltd.: EUSIDIC Database Guide 1987, Books and Periodicals Online, Optical Publishing Directory and The CRI Directory of Expert Systems.
INFOTRAC II	B	Information Access Co. 11 Davis Drive, Belmont, CA 94002, USA	Index to 400 US magazines and journals.
THE INTELLIGENT CATALOG	B	The Library Corporation	Public access catalogue.
INTERNATIONAL	T	Data Base Products Inc. 12770 Coit Road, Suite 1111, Dallas, TX 75251, USA	Data on airline passenger traffic between USA and the rest of the world - broken down by airport.
INTERNATIONAL BOOKS IN PRINT	B	R.R. Bowker Ltd. and the UK.	162 500 English language titles published outside the USA
INTERNATIONAL DICTIONARY OF MEDICINE AND BIOLOGY.	T	John Wiley and Sons Wiley Electronic Publishing, 605 3rd Avenue, New York, NY 10158, USA	Medical dictionary, defining more than 160 000 terms.
INTERNATIONAL ENCYCLOPAEDIA OF EDUCATION	G, T	Pergamon Compact Solutions 12 Vandy Street, London EC2A 2DE, England	1448 articles and graphics on the present day knowlegde of education.
JEPPERSEN CHARTS ON CD-ROM	T	LaserTrak 6235-B Lookout Road, Boulder CO 80301, USA	Charts Service, ARINC database, National Flight Data Centre, Geographic database, Preferred Route database.
KIRK-OTHMER ENCYCLOPAEDIA OF CHEMICAL TECHNOLOGY	T	John Wiley and Sons	Standard reference work on chemistry and chemical industry. Print version is 25 volumes, CD-ROM contains all textual information.
LASERCAT	B	Western Library Network Stop AJ-11W, Olympia, WA 98504, USA	The most useful portion of the Western Library Network Mail database on three CD-ROM disks.

CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
LASERGUIDE	B	General Research Corporation 5383 Hollister Avenue, P.O. Box 6770 Santa Barbara, CA 93160-6770, USA	Public access catalogue for libraries.
LASERQUEST	B	General Research Corporation	The GRC database includes the holdings of more than 100 libraries.
LASERSEARCH	B	Ingram Distribution Group Inc. 347 Reedwood Drive, Nashville TN 37217, USA	Public access catalogue including an electronic ordering process.
LC - MARC - ENGLISH	B	The Library Corporation in the Library of Congress.	Information on books since 1964 and popular titles since 1900
LC - MARC - FOREIGN	B	The Library Corporation	Information on foreign titles in the Library of Congress.
LE PAC	B	Brodart Company 500 Arch Street, Williamsport, PA 17705, USA	Public access catalogue for libraries.
LE PAC: GOVERNMENT DOCUMENTS OPTION	B	Brodart Company	The US Government Printing Office catalogue on CD-ROM.
LE PAC: INTERLIBRARY LOAN OPTION DATABASES.	B	Brodart Company	An interlibrary loan network using MARC-formatted
LEGAL DATABASES ON CD-ROM	T	IBIS Service AG Airgate, Thurgauerstrasse 40, 8050 Zurich, Switzerland	The decisions of the highest court in Switzerland from 1960.
LIBRARY LITERATURE	B	H.W. Wilson Co.	Citations to publications covering aspects of library and information science.
LIFE SCIENCES COLLECTION	B	Microinfo Ltd.	Citations to worldwide life sciences literature.
LISA	B	SilverPlatter Information Services	Citation to literature of librarianship, information science and related disciplines.

B = Bibliographic, T = Text, G = Graphics, N = Numeric, D = Data, A = Audio

CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
THE LUTHER BIBLE	T	Deutsche Bibelgesellschaft Balingenstrasse 31, 7000 Stuttgart, 80 West Germany	The bible according to Martin Luther.
M SERIES 100 WITH DISCON	B	Utias international 80 Bloor Street, West Toronto, Ontario M5S 2V1, Canada	Contains the shelf list of the Library of Congress since the MID 1984.
MARCIVE/PAC	B	MARCIVE Inc. P.O.Box 47058, San Antonio, TX 78265-7508, USA	Catalogue for library's own bibliographic records.
MARK ENCYCLOPAEDIA OF POLYMER SCIENCE AND TECHNOLOGY	T	John Wiley and Sons	19 volume work about applied polymer and plastic Nine volumes are also available in printed form, the rest will be published by the end of 1989. The CD-ROM contains the first five volumes.
MCGRAW-HILL SCIENCE AND TECHNICAL REFERENCE SET	G, T	Microinfo Ltd.	Concise Encyclopaedia of Science and Technology, 15 volumes, and McGraw-Hill Dictionary of Scientific and Technical Terms.
MEDICAL DICTIONARY	T	COMCAL Baseo de Gracia 49, 08007 Barcelona, Spain	Dictionary of medical terms in Spanish.
MEDLINE	B	Microinfo Ltd./SilverPlatter Information Services	Citations to worldwide biomedical literature.
MEDLINE	B	Microinfo Ltd. Cambridge Scientific Abstracts 5161 River Road, Bethesda, MD 20816, USA	See above.
MEDLINE	B	BRS Information Technologies 1200 Route 7, Latham, NY 12110, USA	See above.

CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
MEDLINE	B	Dialog Information Services Inc.	See above.
METROSCAN	T	Digital Diagnostics Inc.	Estate database of County Assessors.
MICROMEDEX	T	Microinfo Ltd.	Information on 300 000 chemicals, drugs and other products.
MICROSOFT BOOKSHELF	T	Microsoft Corp. 16011 NE 36th Way, Box 97017, Redmond, WA 98073, USA	A tool for writers containing ten useful reference works.
MLA INTERNATIONAL BIBLIOGRAPHY	B	H.W. Wilson Co.	Indexes critical documents on literature, language, linguistics and folklore.
MUNDOCHART	G	Chadwyck-Healey Ltd. Cambridge Place, Cambridge CB2 1NR, England Petroconsultants Ltd. Burleigh House 13, Newmarket Road, Cambridge, England	Cartographic maps of the entire world at 1:1M, 1:5M and 1:25M scales.
NEIC DATABASE	D	National Earthquake Information Centre US Geological Survey Box 25046, Denver Federal Centre, Denver, CO 80225, USA	Seismic records of earthquake information worldwide.
NEWSBANK ELECTRONIC INDEX	B	NewsBank Inc. 58 Pine Street, New Canan, CT 06840, USA	Current events information from newspapers and business periodicals.
NTIS - NATIONAL TECHNICAL INFORMATION SERVICE	B	Microinfo Ltd./SilverPlatter Information Services	Citation to US Government sponsored research, development and engineering reports, as well as other analyses prepared by Government agencies.
NTIS - NATIONAL TECHNICAL INFORMATION SERVICE	B	Dialog information Services Inc.	See above.

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CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
O&D PLUS	T, N	Data Base Products Inc.	Quarterly statistics for the US airline industry over a three year period.
OHS MSDS ON DISC	T	Occupational Health Services Inc. 450 7th Avenue Suite 2407, New York, NY 10123, USA	Material Safety Data Sheets on hazardous chemicals.
ONE SOURCE	T	Lotus Development Corp.	Access to financial databases.
OPTEXT	T	ALDE Publishing 7840 Computer Avenue, Minneapolis, MN 55435, USA	The entire Code of Federal Regulations and 15 months of the Federal Register.
OSH-ROM - OCCUPATIONAL HEALTH AND SAFETY	B	Microinfo Ltd./SilverPlatter Information Services	Citation to literature on toxicology, epidemiology, chemistry, industrial hygiene, ergonomics and control technology.
OXFORD ENGLISH DICTIONARY	T	Tri-Star Publishing 475 Virginia Drive Fort, Washington, PA 19034, USA	Oxford English Dictionary, 12 volume set.
PAIS ON CD-ROM	B	Public Affairs Information Service 11 West 40 Street, New York, NY 10018, USA	Citations to literature on business and social sciences with emphasis on contemporary social, economic, and political issues and the making and evaluating the public policy.
PARTS-MASTER	T	National Standards Association 5161 River Road, Bethesda, MD 20816, USA	Catalogue of everything purchased or supplied by the US Department of Defence.
PC SIG LIBRARY	T	PC SIG	Some 16 000 public domain PC programmes.
PERSONNET	T	Information Handling Services 15 Inverness Way, East Englewood, CO 80150, USA	Federal personnel manuals, personnel management standards, job descriptions, merit systems and Federal Labour Relations Authority case decisions.
PHINET - PRIVATE LETTER RULINGS	T	Prentice Hall Inc. 1 Golf & Western Plaza, 18th Floor, New York, NY 10023, USA	Over 50 000 private letter rulings issued by the US Internal Revenue Service, from 1987 back to 1977.

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CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
PHINET - REVENUE RULINGS & PROCEEDINGS	T	Prentice Hall Inc.	All the US revenue rulings and revenue procedures dating back to 1959.
PHINET - TAX COURT MEMORANDUM & REPORTED DECISIONS	T	Prentice Hall Inc.	US tax court memorandum and reported decisions.
POPULATION STATISTICS	T, N	Slater Hall Information Products	Full range of population and housing characteristics from the 1980 US census.
THE POSTCODE ADDRESS FILE	T,N	SilverPlatter Information Services	Every address and postcode in UK.
PSYCLIT	B	Microinfo Ltd./SilverPlatter Information Services	Citations to international literature on psychology.
PUBLISHERS INTERNATIONAL DIRECTORY WITH ISBN INDEX	B	R.R. Bowker Ltd.	190 000 publishers throughout the world.
RAINBOW THE CONNECTION: HOMEBASE	T	Tetragon Systems Inc. 5455 Pare Suite 101-2, Montreal Quebec H4P 1R1, Canada	The telephone directories (White pages) of Canada.
READERS' GUIDE ABSTRACTS LANGUAGE GENERAL	B	H.W. Wilson Co.	Citations with abstracts to 182 of the most popular English interest journals in the US and Canada.
READERS' GUIDE TO PERIODICAL LITERATURE	B	H.W. Wilson Co.	Same as above, but without abstracts.
REGISTRY OF MASS SPECTRAL DATA	T, N G	John Wiley and Sons	123 704 spectra records.
SCIENCE HELPER K-8	T	PC SIG	1000 public domain science and mathematics lesson plans developed in the 1960's and 70's for children from kindergarten to grade 8.

CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
SKELLEFTEBOR UNDER 200 AR	T, N	Demografiska Databasen Box 94 Storgatan 69, 953000 Haparanda, Sweden	Demographic data for a Swedish town called Skelleftea for the years 1720 - 1900.
SOCIAL SCIENCE INDEX	B	H.W. Wilson Co.	Citations to literature in 300 English language periodicals in social science.
SOCIOFILE	B	Microinfo Ltd./SilverPlatter Information services	Citations to more than 1 500 serials published worldwide in sociology and nearby disciplines.
SPECTRUM 200 SERIES	B	Library Systems and Services 20251 Century Boulevard, Germantown, MD 20874-1162, USA	System to put client library on CD-ROM.
STATE EDUCATION ENCYCLOPAEDIA: TEXAS	T	Quantum Access Inc. 1700 West Loop, South Suite 1460, Houston, TX 77027, USA	Containing State and Federal statutes, laws and guidelines relating to education and over 4 500 special documents.
SUPERMAP 1.0 1981 AUSTRALIAN CENSUS	T, N G	Chadwyck-Healey/ Space-Time Research Pty Ltd. 668 Burwood Road Hawthorn East, Melbourne Victoria 3123, Australia	Data from the 1981 Australian census.
SUPERMAP 1.1 1980 US CENSUS COUNTY LEVEL FILES STFI-C, STFII-C, COSTAT-2	T, N G	Chadwyck-Healey/ Space-Time Research Pty Ltd.	Data from the 1980 USA census.
SWEDISH CENSUS DATA	T, N G	National Land Survey of Sweden 80112 Havle, Sweden	Census data of Sweden.
TERMDOK	T	Walter's Lexikon Sodermalmstorg 8, 11645 Stockholm Sweden	Contains 25 000 Swedish technical terms with 100 000 equivalents in English, French, German, and some terms Danish, Norwegian, Finnish and Spanish.
TLRN (TECHNICAL LOGISTICS REFERENCE NETWORK)	T	Innovative Technology Inc. 2927 Jones Branch Drive, McLean, VA 22102, USA	Access to the full Federal Safety Catalogue containing information on 6 000 000 items which the Federal Government uses.

CD-ROM PRODUCTS

TITLE	TYPE	VENDOR AND ADDRESS	DESCRIPTION
TWIXTEL 87	T	Twix Equipment AG Gewerbstrasse 12 Ch-8132 Egg, Switzerland	Official telephone directories of Switzerland.
ULRICHS PLUS	B	R.R. Bowker	Ulrichs International Periodicals Directory on CD-ROM.
UNIVERSE OF SOUNDS	D	Optical Media Internat., 485 Alberto Way, Los Gatos, CA 95032, USA	Sound samples.
UNIVERSITY OF GUELPH ONLINE CATALOGUE ON CD-ROM	B	University of Guelph Guelph Ontario, N1F 2W1, Canada	The whole University library catalogue.
US FEDERAL PROCUREMENT CD-ROM	T	ALDE Publishing	The GSA Supply Catalog.
USSR SOURCE 21	T	ALDE Publishing	Contains Soviet history.
VISUAL DICTIONARY	T, A I	Facts on File Inc. 460 park Avenue South, New York NY 10016, USA	Designed primarily for foreign language. It combines text, audio and images, allowing users to find the proper word, picture and pronunciation for an object in French or English.
WILSONDISC	B	The H.W. Wilson Company 950 University Avenue, Bronx New York 10452, USA	Twelve Wilson databases, each as a separate disk.
WER LIEFERT WAS?/WHO SUPPLIES WHAT?	T	Wer liefert was? GmbH Normannenweg 18-20, 2000 Hamburg, 26 West Germany	Addresses, communication data and products of all companies listed in the printed version of "Who supplies what?".
WORLD ATLAS	G T, N	DeLorme Mapping Systems Inc. Lower main Street, P.O. Box 289, Freeport Maine 04032, USA	World atlas.
YOUR MARKETING CONSULTANT	T, N G	Knowledge Access International 2685 Marine Way Suite 1305, Mountain View, CA 94043, USA	Demographic data.

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CD-ROM MANUFACTURERS AND COMPANIES FOR DATA PREPARATION

COMPANY NAME AND SERVICES	ADDRESS
Access innovations (data preparation)	P.O. Box 40130 Albuquerque, NM 87196 USA
Acctex Information Systems (data preparation)	131 Stuart Street Suite 600 San Francisco, CA 94105 USA
Activenture (data preparation)	P.O. Box 51125 Pacific Grove, CA 93940 USA
Advanced Graphic Applications, Inc. (data preparation)	350 5th Avenue New York, NY 10036-5198 USA
Advanced Image Technology, Inc. (data preparation)	100 Park Avenue 34th Floor New York, NY 10017 USA
Advanced Touch Systems (data preparation)	9669 Distribution Avenue San Diego, CA 92121 USA
ALDE Publishing (data preparation)	7840 Computer Avenue P.O.Box 35326 Minneapolis, MN 55435 USA
ALTA Associates (data preparation)	555 Metro Place North Suite 175 Dublin, OH 43017 USA
American Interactive Media, Inc. (data preparation)	11111 Santa Monica Boulevard Suite 1000 Los Angeles, CA 90025 USA
AMTEC Information Services (data preparation)	3700 Industry Avenue Lakewood, CA 90714-6050 USA
Archetype Systems Ltd. (consultancy, CD-ROM preparation and production, data and graphics conversion)	Boundary House 91-93 Charterhouse Street London EC1M 6LN, England
Arctan Graphic Arts, Inc. (data preparation)	8 Prince Street Rochester, NY 14607 USA

COMPANY NAME AND SERVICES	ADDRESS
Audio Matrix, Inc. (CD-ROM disk manufacturer)	400 Madison Avenue New York, NY 10017 USA
Auto-Graphics, Inc. (data preparation)	3201 Temple Avenue Pomona, CA 91768 USA
BCB Bertelsmann Computer Beratungsdienst GmbH (CD-ROM disk manufacturer)	Heidenkampsweg 44 D - 2000 Hamburg 1 West Germany
Brodart Automation (data preparation)	500 Arch Street Williamsport, PA 17705 USA
CD Mastering AB (CD-ROM disk manufacturer)	Box 9173 S - 20039 Malmö Sweden
Center for Educational Technology (data preparation)	406 EDU Florida State University Tallahassee, FL 32306 USA
Centre Production Group/ Major Lytton Productions (data preparation)	6311 N. O'Connor 3 Dallas Comm. Complex LB81 USA
Compact Discoveries (data preparation)	1050 South Federal Highway Delray Beach, FL 33444 USA
Corning Glass Works (CD-ROM disk manufacturer)	MP-21-3 Corning, NY 14831 USA
Data Horizons, Inc. (data preparation)	47-15 33rd Street Long Island City, NY 11101 USA
Dataware (data preparation)	2 Greenwich Plaza Suite 100 Greenwich, CT 06830 USA
DeLorme Mapping Systems (data preparation)	P.O. Box 298 Freeport, ME 04032 USA
Denon America (data preparation)	27 Law Drive Fairfield, NJ 07006 USA
Digipress (CD-ROM disk manufacturer)	10 rue de Paris 78100 Saint Germain en Lye France

COMPANY NAME AND SERVICES	ADDRESS
Digital Audio Disc Corporation (CD-ROM disk manufacturer)	1800 North Fruitridge Avenue Terre Haute, IN 47805 USA
Digital Equipment Corporation Optical Products (data preparation)	2 Mount Royal Avenue UP01-3 Marlboro, MA 01752 USA
Dital United (data preparation)	282 Cabrini Boulevard 6th Floor New York, NY 10040 USA
Disclosure (data preparation)	5161 River Road Bethesda, MD 20816 USA
Discovery Systems (data preparation, CD-ROM disk manufacturer)	7001 Discovery Boulevard Dublin, OH 43017 USA
Disctronics, Ltd. (data preparation, CD-ROM disk manufacturer)	34 Queen Street 9th Floor Melbourne, Victoria 3000 Australia
DOCdata N.V. (CD-ROM disk manufacturer)	P.O. Box 1021 Venlo 5900 VA Netherlands
Documentary Reproduction Service (data preparation)	160 5th Avenue New York, NY 10010 USA
Du Pont Company (CD-ROM disk manufacturer)	Wilmington, DE 19898 USA
Elektoson, b.v. (data preparation, simulation)	Huis Groot Velder Velderseweg 14 5298 LE Liempde Netherlands
EBSCO Electronic Information (data preparation)	23717 Hawthorne Boulevard Suite 301 Torrance, CA 90505 USA
European Interactive Media (data preparation, CD-ROM disk manufacturer)	45 Berkeley Square London W1X 5DB United Kingdom
General Research Corporation, Library Systems (data preparation)	5383 Hollister Avenue Santa Barbara, Ca 93111 USA

COMPANY NAME AND SERVICES	ADDRESS
Geovision, Inc. (data preparation)	270 Scientific Drive Suite 1 Norcross, GA 30092 USA
Group L Corporation (data preparation)	481 Carlisle Drive Herndon, VA 22070 USA
High Tech Manufacturers, Ltd. (data preparation)	522 west 28th Street No. Vancouver, B.C. V7N 2J5 Canada
Hitachi Sales Corporation of America (CD-ROM disk manufacturer)	401 West Artesia Blvd. Compton, CA 90220 USA
Image Conversion Technologies (data preparation)	80 Blanchard Road Burlington, MA 01803 USA
Image Management Systems, Inc. (data preparation)	One Richmond Square Providence, RI 02906 USA
InfoCorp (data preparation)	20833 Stevens Creek Boulevard Cupertino, CA 95014 USA
Inform II (data preparation)	4999 Ste. Catherine West Suite 430 Westmount, Quebec H3Z 1T3 Canada
Interactive Television Company (data preparation)	1800 N. Kent Street Suite 920 Arlington, VA 22209 USA
Interactive Training Systems, Inc. (data preparation)	9 Oak Park Drive Bedford, MA 01730 USA
International Computaprint Corp. (data preparation)	475 Virginia Drive Fort Washington, PA 19034 USA
Knowledge Access International (data preparation)	2685 Marine Way Suite 1305 Mountain View, CA 94043 USA

COMPANY NAME AND SERVICES	ADDRESS
KnowledgeSet Corp. (data preparation)	60 Garden Court Bldg. A; 3rd Floor Monterey, CA 93940 USA
LaserData, Inc. (data preparation)	10 Technology Drive Lowell, MA 01851 USA
LaserVideo, Inc. (CD-ROM disk manufacturer)	One East Wacker Drive Chicago, IL 60601 USA
The Library Corporation (data preparation)	P.O. Box 40035 Washington, DC 20016 USA
Marubeni America Corporation (CD-ROM disk manufacturer)	2000 Town Center Suite 2150 Southfield, MI 48075 USA
Meridian Data, Inc. (data preparation, simulation)	4450 Capitola Road Suite 101 Capitola, CA 95010 USA
MetaMedia Systems, Inc. (data preparation)	20251 Century Boulevard Germantown, MD 20874 USA
MicroTRENDS, Inc. (data preparation)	650 Woodfield Drive Suite 730 Schaumburg, IL 60173 USA
M.P.O. (data preparation, CD-ROM disk manufacturer)	Averton 53700 Villaines La Juhel France
MTE Associates, Inc. (data preparation)	P.O. Box 2477 Del Mar, CA 92014 USA
Omni Computer Systems, Inc. (data preparation)	670 Centre Street Jamaica Plain, MA 02130 USA
OCLC (Online Computer Library Center) (data preparation)	6565 Frantz Road Dublin, OH 43017-0702 USA

COMPANY NAME AND SERVICES	ADDRESS
Online Computer Systems, Inc. (data preparation)	20251 Century Boulevard Germantown, MD 20874 USA
Optical Media International (data preparation, CD-ROM disk manufacturer)	485 Alberto Way Los Gatos, CA 95032 USA
PC Consultant AB (data preparation, simulation)	Box 205 54125 Skövde Sweden
Perceptronics (data preparation)	1911 N. Fort Myer Drive Arlington, VA 22209 USA
Philips & DuPont Optical Company (data preparation, CD-ROM disk manufacturer)	P.O. Box 400 Grover, NC 28073 USA
Philips International B. V. (data preparation, CD-ROM disk manufacturer)	P.O. Box 218, Building V0 1 5600 MD Eindhoven Netherlands
Polyform, Inc. (data preparation, CD-ROM disk manufacturer)	516 South 5th Avenue Mt. Vernon, NY 10550 USA
Publishers Data Service Corporation (data preparation)	2511 Garden Road Building C Monterey, CA 93940 USA
Reference Technology, Inc. (data preparation)	5655 Lindero Canyon Road Westlake Village, CA 91362 USA 5700 Flatiron Parkway Boulder, CO 80301, USA 2070 Chain Bridge Road Suite 500 Vienna, VA 22180 USA 24165 Summit Woods Drive Los Gatos, CA 95030 USA 7027 Nicki Street Dallas, TX 65252 USA

COMPANY NAME AND SERVICES	ADDRESS
Reteaco, Inc. (data preparation)	716 Gordon Baker Road Toronto, Ontario M2H 3B4 Canada
Scotch 3M Optical Recording Project (data preparation, CD-ROM disk manufacturer)	420 North Bernardo Avenue Mountain View, CA 94043 USA
Shape Optimedia, Inc. (data preparation, CD-ROM disk manufacturer)	Route 109 & Eagle Drive Sanford, ME 04073 USA
SilverPlatter Information, Inc. (data preparation)	37 Walnut Street Wellesley Hills, MA 02181 USA
Software Mart, Inc. (data preparation)	4131 Spicewood Springs Road Suite I-7 Austin, TX 78759 USA
Source Interactive (data preparation)	940 Wadsworth Boulevard Lakewood, CO 80215 USA
Space Time Research, Ltd. (data preparation)	27-31 King Street Melbourne, Victoria 3000 Australia
Spafax USA, Inc. (data preparation)	1355 Terrell Mill Road Building 1476 Atlanta, GA 30067 USA
Technidisc, Inc. (data preparation, CD-ROM disk manufacturer)	2250 Meijer Drive Troy, MI 48084-7111 USA
Telesystemes - Questel (data preparation)	83-85 Boulevard Vincent Auriol Paris, 75013 France
TMS, Inc. (data preparation)	110 West 3rd Street P.O. Box 1358 Stillwater, OK 74076 USA
3M Optical Recording Project (CD-ROM disk manufacturer)	3M Center, Building 225-4S-09 St. Paul, MN 55144-1000 USA
U.S. Digital Disc Corporation (data preparation, CD-ROM disk manufacturer)	14 Holland Road Middletown, NJ 07748 USA

COMPANY NAME AND SERVICES	ADDRESS
University Microfilms, Inc. (data preparation)	300 N. Zeeb Road Ann Arbor, MI 48106 USA
Utlas International U.S., Inc. (data preparation)	8300 College Boulevard Overland Park, KS 66210 USA
Varitel Video (data preparation, CD-ROM disk manufacturer)	350 Townsend Street San Francisco, CA 94107 USA
VLS, Inc. (Video Laser System) (data preparation)	310 S. Reynolds Road Toledo, OH 43615 USA

INFORMATION SOURCES

1 ONLINE DATABASES

The following online databases include bibliographical data about optical information systems and CD-ROMs both for retrospective information retrieval and selective dissemination of information:

- COMPENDEX
- THE COMPUTER DATABASE
- CONFERENCE PAPERS INDEX
- Ei ENGINEERING MEETINGS
- THE ELECTRONIC MAGAZINE
- ELECTRONIC PUBLISHING ABSTRACTS
- ERIC
- INFORMATION SCIENCE ABSTRACTS
- INSPEC
- LIBRARY AND INFORMATION SCIENCE ABSTRACTS
- NTIS
- PASCAL
- NPADOC
- PATSEARCH
- WORLD PATENTS INDEX

The NewsNet system is a good source of specialized business information. NewsNet contains approximately 300 timely services from independent, authoritative publishers.

The more detailed descriptions (type, subject, producer, online service, conditions, content, language, coverage, time span and updating) about these databases are presented in the Directory of online databases, vol. 8, no 3. published by Cuadra/Elsevier in USA (Anon. 1988).

2 JOURNALS

There are nowadays many journals containing articles about CD-ROM and other optical media like videodisks, WORM disks and lasercards, but only a few concentrate mainly on CD-ROMs. These journals are marked with an asterisk in the following list. More information and sample copies may be asked from the publishers. The list is collected by the aid of the CD-ROM Directory 1988 edited by Kate Churchill and published by TFPL Publishing in London (Churchill 1987).

TITLE	PUBLISHER	FREQUENCY
* CD Data Report	Langley Publications, 1350 Beverly Rd., Ste. 115 -324, McLean, VA 22101, USA	Monthly
CD-I News	LINK Resources Corp., 12th Floor, 79 Fifth Avenue, New York, NY 10003, USA	Monthly
* CD-ROM	A Jour, Transtex International 10 rue Danielle Casanova 75002 Paris, France	Monthly
* CD-ROM Business Information	Headland Press 1 Henry Smith's Terrace Headland Cleveland TS24 0PD, England	Monthly
* CD-ROM International	A Jour, Transtex International 10 rue Danielle Casanova 75002 Paris, France	11 issues p.a.
* CD-ROM Librarian	Meckler Ltd. Grosvenor Gardens House Grosvenor Gardens, London SW1W 0BS, England	10 issues p.a.
* CD-ROM Newsletter	Microinfo Ltd., P.O. Box 3 Omega Park, Alton Hants GU34 2PG, England	Irregular
* CD-ROM Review	CW Communications Elm Street, Peterborough NH 03458, USA	Monthly
Digital Audio	WGE Publishing Inc, Peterborough, NH 03458, USA	Monthly
The Digital Recording Report	Technical Systems Group, 195 Willowbrook Avenue Stanford, CT 06902, USA	Monthly
The Electronic Library	Learned Information Ltd., Woodside, Hinksey Hill, Oxford OX1 5AU, England	Bimonthly
Electronic and Optical Publishing Review	Learned Information Ltd., Woodside, Hinksey Hill, Oxford OX1 5AU, England	Quarterly

TITLE	PUBLISHER	FREQUENCY
Electronic Publishing Abstracts	Pergamon Journals Ltd Headington Hill Hall Oxford OX3 0BW, England	Monthly
Electronic Publishing Business	Electronic Publishing Ventures Inc. 4701 Montgomery Lane Bethesda, MD 20841, USA	Monthly
Electronic Publishing News	The Publishers Association 19 Bedford Square London WC1B 3HJ, England	Bimonthly
Information Market	Commission of European Communities Directorate-General XIII 177 Route d'Esch, L-1471 Luxembourg	Quarterly
Information Media and Technology	CIMTECH The Hatfield Polytechnic P.O.Box 109, Cottage Lane Hatfield, Herts AL10 9AB, England	Bimonthly
Information World Review	Learned Information Ltd. Woodside, Hinksey Hill Oxford OX1 5AU, England	Monthly
Infotecture	A Jour Transtex International 10 rue Danielle Casanova 75002 Paris, France	Bimonthly
Infotecture Europe	A Jour Transtex International 10 rue Danielle Casanova 75002 Paris, France	22 issues p.a.
Interactive Media, International Newsletter	PLF Communications Cross Street Court, Cross Street Peterborough PE1, England	Monthly
* International Videodisc CD-ROM & Digital Disc Journal	Learned Information Ltd. Woodside Hinskey Hill Oxford OX1 5AU, England	Quarterly
Journal of Information and Image Management	AAIM, 1100 Wayne Ave., Silver Spring, MD 20910, USA	Monthly
* The Laserdisk Professional (from the publisher of ONLINE and Database)	The Laserdisk Professional 11 Tannery La. Weston, CT 06883, USA	Bimonthly

TITLE	PUBLISHER	FREQUENCY
Library Hi Tech Journal	Pieran Press Inc., P.O. Box 1808, Ann Arbor, MI 48106, USA	Quarterly
Library Hi Tech News	Pieran Press Inc. P.O.Box 1808, Ann Arbor MI 48106, USA	Monthly
* Memoires Optiques, the International Videodisk and Digital Optical Disk	ARCA Editions, 97 rue Mme Mole, 56000 Vannes France	Monthly
Online Libraries and Microcomputers	Information Intelligence Inc. P.O. Box 31098, Phoenix AZ 85046, USA	10 issues p.a.
Optical Data Systems	Microinfo Ltd. P.O. Box 3, Omega Park, Alton Hants GU34 2PG, England	Monthly
Optical Information Systems	Meckler Ltd. Grosvenor Gardens House Grosvenor Gardens London SW1W 0BS, England	Bimonthly
Optical Information Systems Update	Meckler Ltd. Grosvenor Gardens House Grosvenor Gardens London SW1W 0BS, England	22 issues p.a.
Optical Memory News	Rothchild Consultants Inc, PO Box 14817, San Francisco CA 94114-1496, USA	Monthly
Publishing and New Media Technology Newsletter	Pergamon Journals Ltd. Headington Hill Hall Oxford OX3 0BW, England	Fortnightly
* State of the CD-ROM Industry: Applications, Players & Products	Information Workstation Group 501 Queen Street, Alexandria VA 22314, USA	3 updates per year
The Videodisc Monitor	Future Systems Inc., PO Box 26, Falls Church, VA 22046, USA	Monthly
Videodisque	A Jour, Transtex International 10 rue Danielle Casanova 75002 Paris, France	Bimonthly
* Whitaker's CD-ROM Newsletter	J. Whitaker and Sons Ltd. 12 Dyott Street London WC1A 1DC, England	Irregular

3 CONFERENCES AND EXHIBITIONS IN 1988

TITLE	VENUE AND DATE	ORGANISER
Annual AIIM Conference & Exposition	Chicago, Illinois, USA 11 - 14 April 1988	AIIM, 1100 Wayne Ave., Silver Spring, MD 20910, USA
CD 88 Versailles	Palais Des Congres, Paris France, June 1988	Le Gffil, 24 Rue de L'Arcade, 75008 Paris, France
CD-ROM EXPO 1988	Chicago, USA 26 - 29 September 1988	IDG Conference Management Group, Box 9171, 375 Cochituate Road, Framingham, MA 01701, USA
Document Management Systems Conference	Folkets Hus, Stockholm, Sweden, 25 - 27 May 1988	International Information Management Conference, PO, Box 34404, Bethesda, MD 20817, USA
Electronic Imaging 1988	Anaheim, Southern California, USA, 29 - 31 March 1988	M.G. Expositions Group, 10/50 Commonwealth Avenue, Boston, MA 02215, USA
The Electronic Publishing & Print Show	Wembley Exhibition and Conference Centre, London England, 14 - 16 June 1988	Online International Ltd., Pinner Green House, Ash Hill Drive, Pinner, Middlesex HA5 2AE, England
The Future of Optical Memory Technology - 3rd Annual Conference	Keisanren Kaikan, Tokyo, Japan, 20 - 22 September 1988	Rothchild Consultants, 256 Laguna Honda Boulevard, San Francisco, CA 94116 - 1496 USA
Interactive Images on CD-ROM and WORM	California, USA Spring 1988	Institute for Graphic Communication 375 Commonwealth Avenue, Boston, MA 02155, USA
International Conference on CD-ROM - 3rd	Sheraton Hotel, Seattle, Washington, USA 1 - 3 March 1988	Microsoft, 16011 Northeast 36th Way Box 97017, Redmond, WA 98073-9717, USA
Laseractive 88 Boston	Hynes Convention Center, Boston, Mass., USA 25 - 28 October 1988	Video Computing, PO Box 3415, Indialantic, FL 32903, USA
Laseractive 88 Chicago	Fairmont Hotel, Chicago Illinois, USA 12 - 15 April 1988	Video Computing, PO Box 3415, Indialantic, FL 32903, USA
Laseractive 88 Toronto	Constellation Hotel, Toronto, Canada, 8 - 10 June 1988	Video Computing, PO Box 3415, Indialantic, FL 32903, USA
Optical Drive and Media Manufacturing - Second Annual Conference and Exposition	San Francisco Airport Hilton, San Francisco, California, USA, 19 - 21 July 1988	Rothchild Consultants, 256 Laguna Honda Boulevard, San Francisco, CA 94116 - 1496 USA
Optical Information Systems International '88	Novotel, London, England 13 - 15 June 1988	Meckler Ltd., Grosvenor Gardens House, Grosvenor Gardens, London SW1W 0BS, England

TITLE	VENUE AND DATE	ORGANISER
Optical Memory Applications Second Annual Conference and Exposition	Tara Hotel, London, England 16 - 18 February 1988	Rothchild Consultants, 256 Laguna Honda Boulevard, San Francisco, CA 94116 - 1496 USA
Optical Storage 88	Hyatt Regency Hotel, Denver, Colorado, USA, 16 - 18 May 1988	Carlidge & Associates Inc., 1101 South Winchester Blvd, Suite M259, San Jose, CA 95128, USA
Optical Storage of Documents and Images - Sixth Annual Conference	Sheraton National Hotel, Arlington, Virginia, USA, 24 - 27 October 1988	Rothchild Consultants, 256 Laguna Honda Boulevard, San Francisco, CA 94116 - 1496 USA
Optical Storage for Large Systems - Third Annual Conference	Sheraton Centre & Towers, New York, USA	Rothchild Consultants, 256 Laguna Honda Boulevard, San Francisco, CA 94116 - 1496 USA
Optical Storage for Small Systems - Fourth Annual Conference	San Francisco Airport Hilton San Francisco, California, USA 19 - 21 April 1988	Rothchild Consultants, 256 Laguna Honda Boulevard, San Francisco, CA 94116 - 1496 USA
SCIL International 1988	Ramada Inn West, London, England, 23 - 25 February 1988	Meckler Ltd., Grosvenor Gardens House, Grosvenor Gardens, London SW1W 0BS, England
Technology Opportunity Conference	Tara Hotel, London, England 16 - 18 February 1988	Microinfo Ltd., PO Box 3, Newman Lane, Alton, Hants GU34 2PG England

Most of these conferences and exhibitions are annual.

4 FURTHER READING

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